RS&H

January 2026

Ted Stevens Anchorage International Airport Master Plan Update
Appendix E – Electric Vehicle Infrastructure Forecast for Parking and ConRAC Operations

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E.1 EV Drivers, Baseline, and Forecast

Several factors are driving transportation electrification and are likely to influence ANC's electrification efforts over the planning period. The number of electric vehicles (EV) nationally and locally is small in 2024 but has been growing rapidly. Extrapolating from this baseline, several forecasts of EV market trends exist. These are benchmarked and set on a common basis to forecast EV growth for the Anchorage region.

E.1.1 Drivers

Several interrelated factors are driving wider adoption of EVs, including automobile manufacturer strategy, consumer preferences, technology, and public policy.

E.1.1.1 Manufacturers

There has been a proliferation of EV models produced by automakers in recent years. There were 83 EV models available in the United States in 2023 which was up from 49 in 2020. Chrysler and Ford expect half of their vehicles to be electric by 2030 and General Motors will produce only zero-emissions vehicles (ZEV) by 2035. The major foreign automakers (e.g., BMW, Honda, Hyundai, Mazda, Nissan, Subaru, Toyota, Volkswagen, and Volvo) have set similar targets. Seven major automakers announced a partnership in 2023 to develop a 30,000-unit network of high-speed EV chargers across Canada and the United States by 2030.

E.1.1.2 Consumers

More than one-third of consumers who intend to buy a car would choose an EV, according to Consumer Reports, for reasons including reduced costs to charge an EV versus refueling a gas car and lower overall lifetime costs. This preference is supported by a spike in EV sales in 2022, even as overall vehicle sales declined. A study done by the Nickel Institute reported that the total cost of ownership of an EV is lower than that of an internal combustion engine (ICE) vehicle due to subsidies and the high residual value of EVs.

Key Electrification Terminology

- *Battery Electric Vehicles (BEV)* are powered by an electric motor and battery charged from an external source.
- *Plug-in Electric Hybrid Vehicles (PHEVs)* have an electric motor and chargeable battery as well as an internal combustion engine (ICE). They run on either electricity or gasoline.
- *Electric Vehicles (EV)* encompass both BEVs and PHEVs
- A *Zero Emission Vehicle (ZEV)* does not directly exhaust pollutants. Most ZEVs are EVs. Hydrogen-powered vehicles are also ZEVs but are uncommon. PHEVs are considered ZEVs in most jurisdictions because they have an EV range of at least 30 miles and the average daily trip is between 30-35 miles, meaning most trips are emissions free.
- An *EV Charger* is a unit that hosts one or more EVSE ports and connectors to charge an EV battery (see EVSE Basics below).
- *EV Support Equipment (EVSE)* includes EV chargers and associated electrical infrastructure.

E.1.1.3 Technology

According to McKinsey, the fast-growing electric mobility industry has attracted more than $400 billion in investment over the past 10 years, driving advancements in electrification, batteries, and autonomous driving. This is reducing EV costs. For example, battery costs, one of the main components of the price of an EV, declined 97% from 1991-2018. Vehicle range has also increased significantly in comparison to the first EVs introduced to the mainstream market. The Nissan Leaf currently has a range of 215 miles and the Tesla Model S can have a range of up to 405 miles. Meanwhile, according to the U.S. Department of Transportation, the average daily miles travelled by an Alaskan is 31.9 miles, less than the 36.1 U.S. average.

E.1.2 Policy

Manufacturers, consumers, and investors are influenced by public policy. Because the automotive industry is global in scale, policies in Europe, the United States, and large U.S. states influence trends in the Anchorage area.

E.1.2.1 Europe

European Union policy targets an EV market share of 50% by 2030 and several countries have announced ICE sales bans in 2030 or 2035. The regulatory-driven European market includes high subsidies for EVs and EV Support Equipment (EVSE). Combined with high consumer demand, Europe is on pace to exceed regulatory targets, which in turn is influencing global auto manufacture strategy.

E.1.2.2 Federal

The U.S. President signed an executive order in 2021 aiming to make half of all new vehicles sold in 2050 zero-emissions vehicles. Meanwhile, the Bipartisan Infrastructure Law is providing over $5 billion over five years to support EVs and EVSE charging stations along highway corridors. The National Electric Vehicle Initiative (NEVI) program is distributing $52 million over five years to Alaska to establish build a statewide EV fast-charging network and community-based charging sites in rural and urban areas across the state, according to NEVI program documents. The Inflation Reduction Act reduces the cost of EVs by expanding tax credits for new and used EVs and providing tax credits for commercial EV fleets and private and commercial EVSE, including tax credits up to 30% of the sales price (Electrification Coalition, 2023). An EV must meet a list of requirements regarding acceptable battery capacity, vehicle weight, and qualified manufacturers to qualify. Two new requirements, added within the last year require EVs to undergo final assembly in North America and to meet critical mineral and battery component specifications. The U.S. President announced more than $6 billion in investments, as of November 14, 2023, to make communities more resilient to the impacts of climate change, with a specific focus on strengthening America's aging electric grid infrastructure. This funding may help address electricity demand concerns of electrification.

E.1.2.3 California

California is a major driver of EV supply and demand in the United States through policy supporting ZEVs. California has required a minimum percentage of passenger cars and light duty trucks to be ZEVs since 1990. That percentage is 17% for 2023 and must be 22% by 2025. Similar standards have been adopted by 17 other states over the years. California updated its standard in 2022 to require all new passenger vehicles sales are zero emissions by the year 2035. Several other states are adopting these new standards. Automakers will prioritize sales in these states with constrained supply. These policies also influence the rate at which automakers permanently shift production of ICE vehicles to EVs.

E.1.2.4 Washington

Washington's EV policy represents a good case study example as the state with the closest geographical ties to Alaska and a similar climate. The Washington State Governor signed a bill in 2022 requiring all vehicles model year 2030 or later sold, purchased, or registered in the state be electric. While the State has yet to develop a strategic plan to reach that goal, Washington has created a plan for electric vehicle infrastructure deployment, spending almost $90 million between 2023 – 2027.

E.1.2.5 Alaska

Alaska's EV policy has lagged slightly behind National policy, due to known risks and challenges associated with the Alaskan infrastructure landscape. Many areas across Alaska are extremely remote and lack significant development, which makes the implementation of EVSE infrastructure difficult to mandate in rural areas. Also, due to the cold climate of Alaska, there are concerns surrounding battery performance of EVs, which may lose up to 50% of their range in cold temperatures. Consumer adoption has also been hindered by supply chain disruptions and Alaskan consumer preference of larger SUVs and trucks. The Alaskan power grid is also extremely isolated and vulnerable to reliability issues.

Alaska has the following laws and incentives in place:

Laws and Regulations:

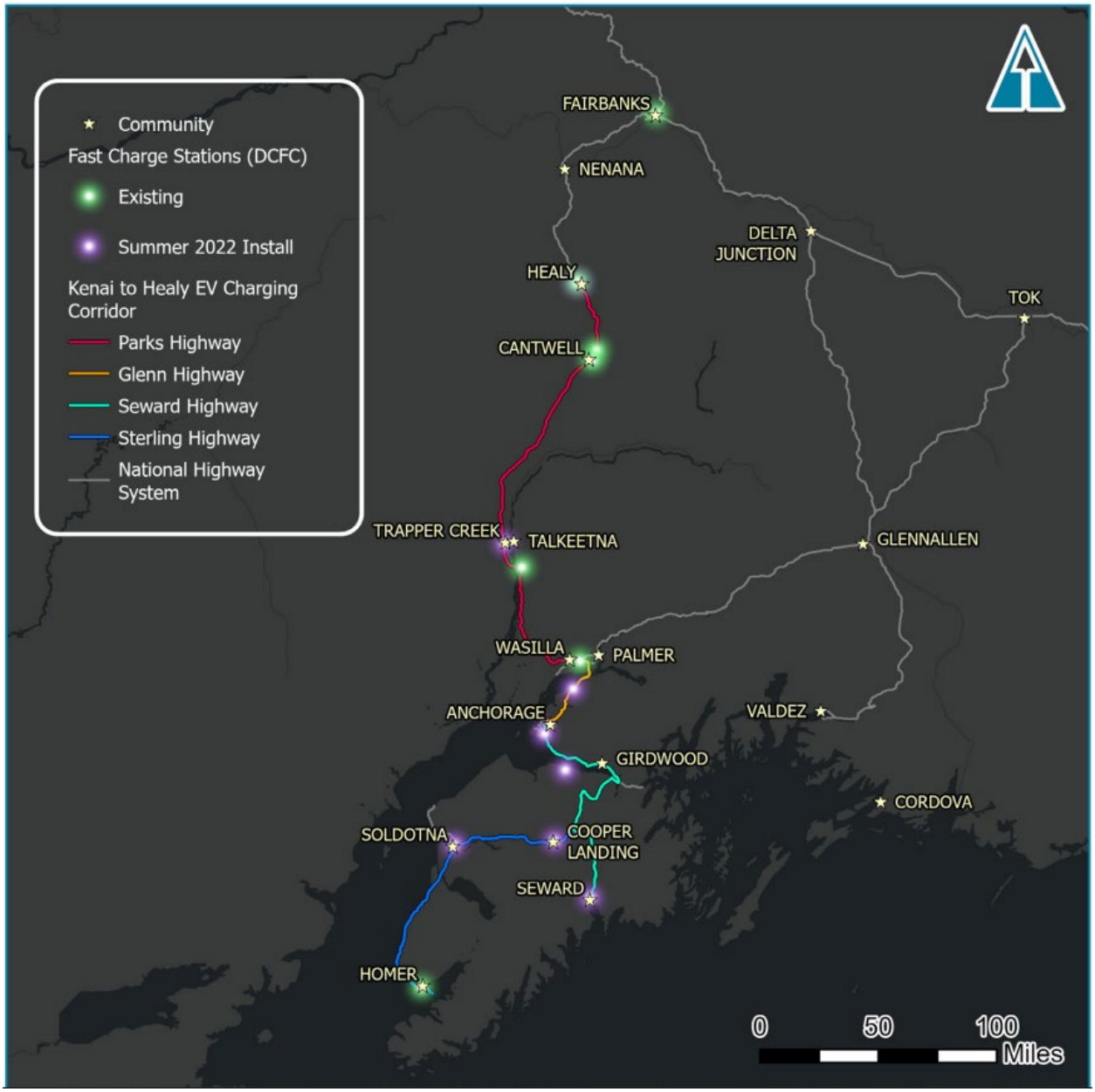
- State Energy Policy: Alaska Statutes 44.99.115 recognizes the importance of promoting energy efficiency in the transportation sector.
- Alternative Fuel Vehicle Acquisition Requirement: Alaska DOT&PF must evaluate alternative fuel cost, efficiency, and commercial availability for automotive purposes. When practical alternative fuel vehicles should be purchased.

Private Incentives:

- Chugach Electric Association (CEA): CEA provides incentives to residents and businesses to encourage the purchase and installation of EVSE infrastructure.
- Alaska Power and Telephone (AP&T): AP&T provides rebates to residents and local governments that purchase or install either EV or EVSE.
- Alaska Electric Light & Power (AELP): AELP provides a "Time-of-Use" (TOU) rate to residential and small commercial customers who own or lease EVs with batteries greater than 16 kilowatts.

Alaska has also received $50 million of National Vehicle Infrastructure (NEVI) funding over the course of five years. This money will be applied to adapt Alaska's unique infrastructure system to support equitable, reliable, and sustainable electric transportation while meeting community and economic needs. **Figure E-1** shows existing and future locations for EVSE infrastructure along the existing Alaskan highway system. Though this funding does not directly impact the Anchorage International Airport, it will significantly impact the rate of penetration within the state as it creates the opportunity for more residents to travel using electric vehicles.

Figure E-1
NEVI Alternative Fuel Corridor



Source: Alaska Energy Authority, 2022

E.1.2.6 City of Anchorage / The Anchorage Metropolitan Statistical Area (MSA)

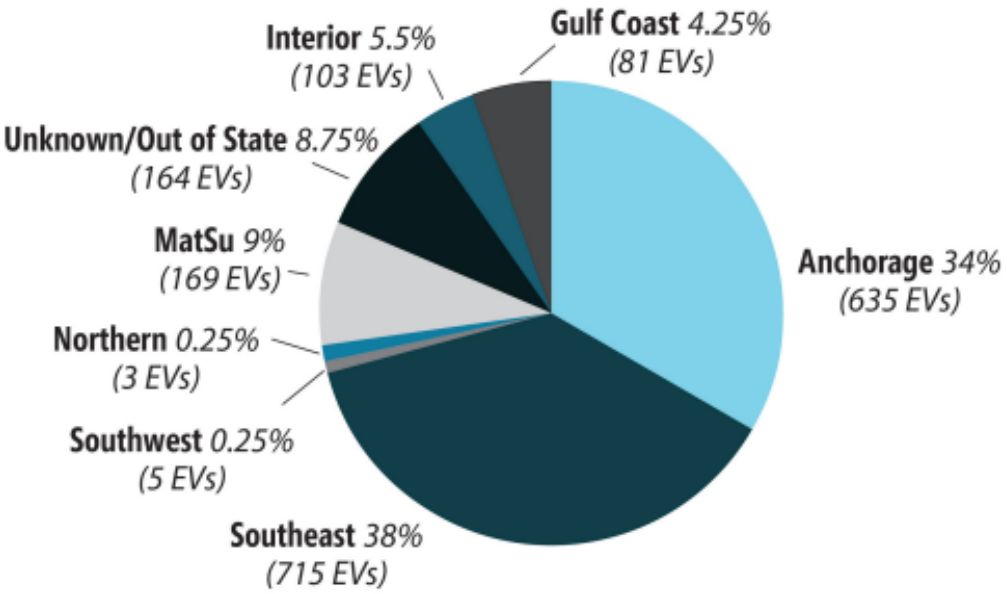
The City of Anchorage is the largest city in Alaska. It makes up two thirds of the entire state's population with approximately 300,000 residents. The State of Alaska's Electric Vehicle Infrastructure Implementation Plan reports that 34% of total EVs in the state are registered in Anchorage, with 9% registered in the nearby Matanuska-Susitna Borough. The splits are summarized in **Figure E-2**.

Public comments on the plan were included in the implementation plan report, and many comments suggested increasing EVSE available within the City of Anchorage and locating chargers at ANC, indicating a public demand for better EVSE infrastructure.

The Municipality of Anchorage developed a Climate Action Plan in 2019. One of the focus areas in this plan is land use and transportation, with a specific objective to promote the use of energy-efficient vehicles. Under this objective, the municipality of Anchorage has pledged to conduct a fleet inventory and develop a procurement policy to incorporate EVs, monitor the economic viability of transitioning the public transit fleet to electric, collaborate on the development of Alaska's Electric Vehicle Infrastructure plan, and to support electric car charging infrastructure by laying conduit for charging and right-sizing electrical panels. Since the development of the Climate Action Plan, Anchorage has received a $950,000 Volkswagen grant fund for electric vehicle charging. The city is planning for a projected total of 25,000 electric vehicles on the road by 2030.

As seen in the map of **Figure E-1**, Anchorage is also one of the endpoints to the NEVI funded alternative fuel corridor, which stretches from Anchorage to Fairbanks. The location of this city along a newly EVSE equipped highway corridor will increase EV accessibility and will increase the demand for charging stations at the Airport.

Figure E-2
Alaska EV Registration by Region



Source: Alaska Energy Authority, 2022

EVSE Basics

Electric vehicles, whether Battery Electric or Plug-in Hybrid Electric require access to Electric Vehicle Service Equipment (EVSE) to charge on-board batteries that power the vehicle electric motor(s). While most EV drivers will charge their vehicles at home, charging stations at destinations like airports remove a key barrier to EV acceptance – access to public charging infrastructure. The rapid growth of EVs in the nation's vehicle fleet requires a robust network of stations.

EVSE consists of EV chargers and supporting electrical infrastructure. EV chargers are classified by the rate the power batteries. This rate is a function of the state of charge (SoC), battery capacity, and the power supply. The latter factor is the basis for the three categories of EV charger: Level 1, Level 2, and DC Fast Charging. **Table A-1** compares them.

Table E-1
EV Charger Comparison

Type	Level 1 (L1)	Level 2 (L2)**	DC Fast Charging (DCFC)**
Charge time (hrs.)*	32	8	0.8
Range per hour of charging (mi)*	5	18	143
Current	AC	AC	DC
Input Voltage	120	208	480
Amperage	20	40	100
Power Output (kW)**	1.92	7.65	50
Charge Efficiency	0.8	0.8	0.95
Installed Cost***	$1,500+	$5,500 - $15,000+	$50,000 - $100,000+

**Charge time from empty (SOC = 0%) assuming the 2022 Fleet average battery capacity (49 kW).*
***Power output and associated amperage can vary between 7 to 19 kW for L2 stations and from 50 to 350 kW depending on charger specifications. Higher power chargers fill batteries more quickly but cost more. The values used in the chart above are typical today but are likely to increase in the future.*
****Rough-order-of-magnitude estimate. Actual costs depend on EV charger features, electrical infrastructure requirements, and site conditions.*

Terminology to describe EV chargers include the following:

- A **charging station** or **charging post** is unit that hosts one or more EVSE ports and connectors. It is typically wall- or bollard-mounted.
- An **EVSE Port** provides power to one EV at a time, even though it may have multiple connectors.
- A **Connector** is plugged into an EV to charge it. Multiple connectors may be available on one EVSE port, but only one EV will charge. There are multiple connector types (J1772, CCS, CHAdeMO, Tesla), which may limit accessibility to certain EV makes and models.

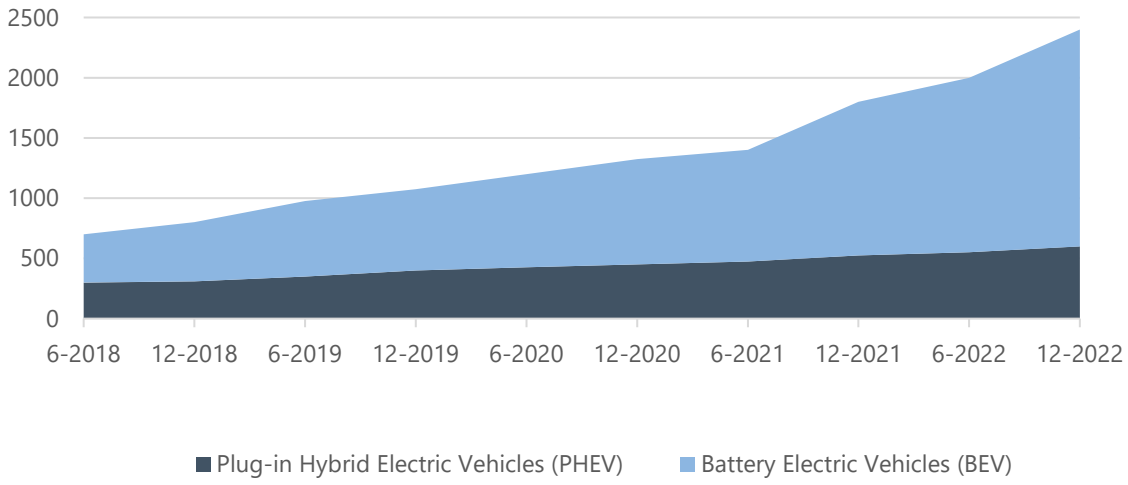
Other important features of EV chargers include the ability to connect to a network to collect payments, meter usage, communicate with, and track status for users and site hosts.

For site hosts with multiple EV chargers, **managed charging** takes advantage of "smart" networked chargers to control energy use, mitigate demand charges, and reduce the need for electrical infrastructure upgrades.

E.1.3 Baseline

Less than 1% of vehicles on the road were EVs in 2023. Over 2.4 million registered vehicles were EVs as of August 2023, according to the U.S. Department of Energy's Alternative Fuels Data Center. The top 5 states for EVs were California, Hawaii, Washington, Oregon, and Nevada when normalized for population. Alaska ranks 36th out of the 51 U.S. States and Territories. Alaska is not registering EVs at a rate proportional to its population, with the state accounting for 0.08% of total EV sales and 0.22% of the total population. There were 1,875 battery electric vehicles (BEV) registered as of May 2023 according to Alaska Department of Transportation and Public Facilities which is equal to about 0.2% of all registered vehicles. This is depicted in **Figure E-3**.

Figure E-3
Electric Vehicles Registered in Alaska



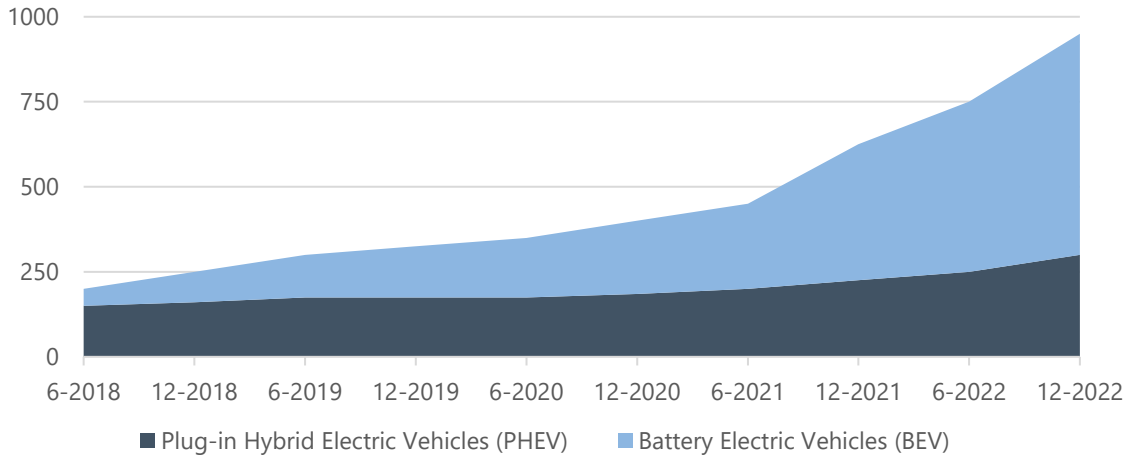
Source: Alaska Department of Transportation and Public Facilities, 2023

The focus area for this study is the Anchorage Metropolitan Statistical Area (Anchorage MSA), encompassing the Municipality of Anchorage (MOA) and the Matanuska-Susitna Borough. Though the population of Anchorage has dropped 0.26% since 2010, Matanuska-Susitna's population has grown 26.42%. Anchorage MSA is an area experiencing increased EV adoption as it is easily accessible and has existing an EVSE. According to the State of Alaska's EV Implementation Plan, in May of 2023, there were 804 EVs registered within the Anchorage MSA, or 43% of total EV registrations in the state, and about two EV registrations per 1,000 people. Vehicles registered in Anchorage account for 79% of EVs in the MSA. The various municipalities of the Southeast region of Alaska account for the second highest adoption rate, at 38% of total EV registrations (715).

Registrations within the Municipality of Anchorage have grown rapidly since 2018 despite overall electric vehicle registration being lower than national averages. According to Chugach

Electric's tracking, electric vehicle registrations grew approximately 375% (from around 200 to around 950 vehicles) in the four years between 1018 and 2022, as described in **Figure E-4**.

Figure E-4
Anchorage MOA EV Registrations



Source: Chugach Electric, 2023

E.1.4 Forecast

Multiple agencies forecast future EV sales and markets. Several projections were benchmarked for this study, including those produced by Bloomberg New Energy Finance (BNEF), Deloitte, EV Adoption (EVA), Boston Consulting Group (BCG), the International Energy Agency (IEA), Wood Mackenzie (WM), the U.S. Energy Information Administration (EIA), and the University of California at Berkeley (UCB). These projections are summarized in **Table E-2**.

Table E-2
EV Forecast Agencies included in the Benchmark

Agency	Description
BCG	BCG is a global consulting firm providing periodic assessments of the EV market. Its 2022 forecast evaluates EV sales market penetration through 2035 with limited no-cost access to underlying data and assumptions. Its projection is the highest included in this benchmark.
BNEF	Bloomberg NEF is a research consultancy covering global commodity markets and decarbonization technology. Their Electric Vehicle Outlook is published annually with limited, no-cost access to the underlying data. The 2022 report is its 7th iteration and projects sales, sales market penetration, and fleet stocks through 2035. BNEF's projections are consistently high-end.
Deloitte	Deloitte is a global consulting firm that produced a 2030 projection of EV sales market penetration. This 2020 report provides limited, no-cost access to the underlying data and assumptions. Its projection is the median for this benchmark.
EIA	The U.S. Energy Information Agency is a subdivision of the US Department of Energy responsible for statistical analysis. Its Annual Energy Outlook includes no-cost access to underlying data supporting its forecast of EV sales through 2050. Its "Reference Case" is the lowest projection in this benchmark.
EVA	EV Adoption produces limited no-cost access EV analysis and forecasts as part of an EV consultancy. Its most recent projection (2021) included estimates of EV sales volumes and penetration, as well as estimates of the future EV fleet, through 2030. Its projection is slightly above the median.
IEA	The International Energy Agency is an intergovernmental statistical agency associated with the Organization for Economic Co-Operation and Development (OECD) member nations. It produces an annual Global EV Outlook projecting sales and fleet volumes through 2030 with unlimited no-cost access to underlying data and assumptions. Its 2023 projection includes two scenarios: the Stated Policies Scenario (STEPS) reflects current policy plans, while the Announced Pledges Scenario (APS) is based on climate-focused policy pledges and announcements. The former is a median projection, while the latter is near the high-end.
UCB	The University of California at Berkeley is a public university whose Center for Environmental Public Policy released its 2035 Report 2.0, evaluating the technical and economic feasibility of vehicle electrification. Its No New Policy scenario evaluates EV sales market penetration under current policy conditions with unlimited no-cost access to underlying data and assumptions. Its projection is just below the median.
WM	Wood Mackenzie is a global research consultancy focused on energy and commodities. In 2020, WM released its 2040 forecast of EV sales volumes with limited access to underlying data and assumptions. Its projection is at the low-end.

Source: Boston Consulting Group, 2022; Bloomberg New Energy Finance, 2022; Deloitte, 2022; U.S. Energy Information Administration, 2023; EV Adoption, 2021; International Energy Agency, 2023; University of California at Berkeley, 2021; Wood Mackenzie, 2020; RS&H Analysis, 2024.

EV forecasts are uncertain, with results highly dependent on methods, assumptions, and intended use. Factors that could affect the results, include:

- **Year**: The EV marketplace is changing rapidly, so the year in which the projection was made could be influential. Projections included in this benchmark range from 2020 to 2023.
- **Sector**: This benchmark includes projections prepared by government agencies, non-government organizations, and for-profit consultancies. Each of the projections may have different audiences in mind when preparing their analyses, which could affect their results.
- **Transparency**: For-profit consultancies do not provide unlimited, no-cost access to the data, assumptions, and methods underlying their projections, while government and non-governmental organization (NGO) projections do. Methodology can have an important impact on results.
- **Horizon**: Long-term forecasts are more uncertain than short ones. The effects of methods and assumptions are more pronounced, with higher variability across projections in later years. This benchmark includes projections that range from 2030 to 2050.
- **Metrics**: Projections included an attempt to predict future EV sales volumes (Sales #), sales market penetration (Sales %), or the future size of the EV fleet (Fleet). Some projections include just one of these metrics and others include a combination of metrics. Sales reflect assumptions about new cars, while fleet projections must forecast the rate at which EVs are added to the existing mix of vehicles.

Table E-3 compares these characteristics among the projections included in this benchmark.

Table E-3
Benchmark EV Forecast Characteristics

	Year	Sector	Transparency	Frequency	Horizon	Metric(s)
BCG	2022	Private	Limited	One-time	2035	Sales %
BNEF	2022	Private	Limited	Annual	2035	Sales #, Sales %, Fleet
Deloitte	2020	Private	Limited	One-time	2035	Sales %
EIA	2023	Gov't	Unlimited	Annual	2050	Sales #
EVA	2021	Private	Limited	Periodic	2030	Sales #, Sales %, Fleet
IEA APS	2022	NGO	Unlimited	Annual	2030	Sales #, Fleet
IEA STEPS	2023	NGO	Unlimited	Annual	2030	Sales #, Fleet #
UCB	2021	NGO	Unlimited	One-time	2050	Sales %
WM	2020	Private	Limited	One-time	2040	Sales #

Source: Boston Consulting Group, 2022; Bloomberg New Energy Finance, 2022; Deloitte, 2022; U.S. Energy Information Administration, 2023; EV Adoption, 2021; International Energy Agency, 2023; University of California at Berkeley, 2021; Wood Mackenzie, 2020; RS&H Analysis, 2024.

Forecasts were adjusted to account for different methods to provide a common basis for comparison.

- Percentages were converted to total EV sales based on the EIA's total passenger vehicle sales projections from 2022 to 2050 for projections that reported sales market penetration.
- Using historical sales data, current fleet data, future projections, and an average vehicle lifespan of 12 years, fleet size projections were derived for all forecasts. For projections that provided total vehicle sales, total fleet size was calculated assuming **3,454,700 EVs registered within the United States in 2023** per the 2023 Annual Energy Outlook published by EIA. This conversion also assumes an EV lifespan of 12 years. The average age of light vehicles in operation in the United States rose to 12.2 years in 2022, and 2022 marks the fifth straight year the average vehicle age has risen.
- Annual values were linearly interpolated for forecasts that did not provide continuous values across time horizons.
- Interpolations beyond 2030 were not made for forecasts that end in that year.
- The EV market share of the future automobile fleet is calculated using EIA's total passenger vehicle fleet projections from 2022 to 2050. Notably, EIA's projection of the growth rate of the total vehicle fleet is lower than its projection of the EV fleet growth rate.

Set on a common basis, the forecasts reflect a wide range of results. They indicate significant uncertainty about future EV sales and their share of the automobile marketplace, as well as the size and market share of the future EV fleet.

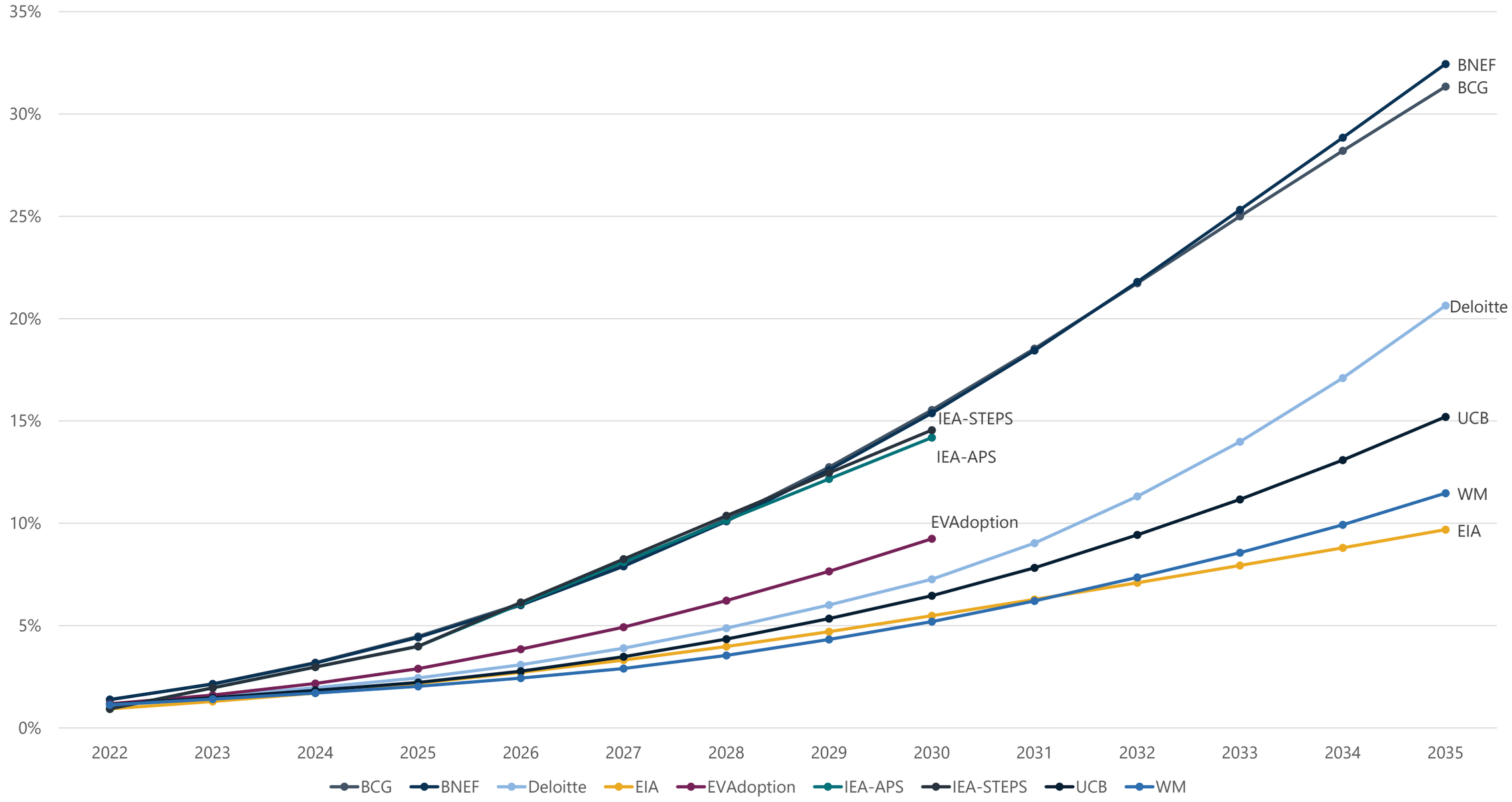
Table E-4 compares projections to 2030, since all forecasts include this time horizon. The EV market share of sales ranges from 14% to more than half of all vehicles. The range of EV market share for fleets is narrower – from 5% to 16%. **Figure E-5** depicts the adjusted EV fleet market penetration through 2035 and illustrates the broad range of projections in 2030 and 2035.

Table E-4
Benchmark EV Forecast Results Comparison

	EV Sales (Millions)	EV Market Share Sales	EV Fleet (millions)	Market Share Fleet
EIA	2.2	14%	14.9	5%
WM	2.8	18%	14.1	5%
UCB	3.4	23%	17.6	6%
Deloitte	3.8	25%	19.8	7%
EVA	4.7	31%	25.1	9%
IEA STEPS	7.8	51%	39.6	15%
IEA APS	7.8	51%	38.6	14%
BNEF	8.0	53%	41.9	15%
BCG	8.1	53%	42.3	16%

Source: U.S. Energy Information Administration, 2023

Figure E-5
Benchmark Forecasts of EV Fleet Market Penetration (2021-2035)

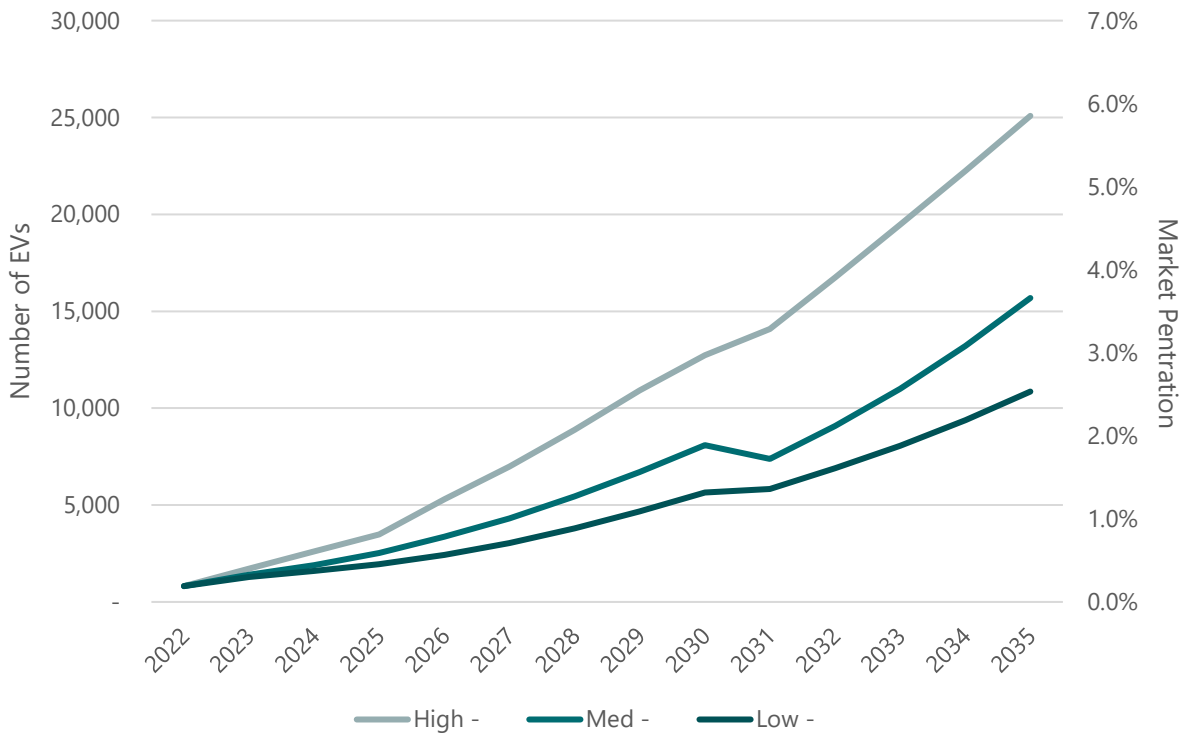


Source: U.S. Energy Information Administration, 2023

Adjusted forecasts were downscaled to the Anchorage MSA to understand how EV projections affect ANC. High, medium, and low growth scenarios were derived by applying 25th, 50th and 75th percentile values from normalized benchmark forecasts to baseline data for the Anchorage MSA.

The results indicate that ANC's planning area could include between about 11,000 and 26,000 EVs by 2035, representing 2.5% to 6% of all vehicles. Each scenario has a high average annual growth rate of about 19% to 27%, as depicted in **Figure A-6**.

Figure E-6
Forecasted EV Fleet and Market Penetration Downscaled to the Anchorage MSA



Source: U.S. Energy Information Administration, 2023; RS&H Analysis, 2024

The uncertainties that apply to forecasting EV sales and stocks nationally also apply locally. The EV market is turbulent. It is characterized by rapid growth, technological innovation, shifting consumer sentiment, and policy changes, including incentives and funding. EV adoption within Alaska also faces unique challenges, including increasing difficulty predicting consumer behavior and technological capacity. There is also reason to believe that Alaska's adoption rate will behave similarly to the national trend as cost becomes less of a barrier for consumers and the availability of SUV and pickup truck EVs increases despite the challenges faced by EVs in Alaska. This EV forecast should be revisited periodically and as conditions change as with any planning factor important to ANC's future.

E.2 Electrification Engagement

Understanding ANC's present and future position relative to peer airports, rent-a-car (RAC) companies, and its electric utility provides important context for this planning effort. The industry is moving quickly towards electrification, and ANC benefits from engaging its aviation peers to gather lessons learned and understand best management practices. Meanwhile, RACs are engaging airports across the nation to support their electrification plans. All RACs are planning for the deployment of EVs and EVSE despite differing public postures. Chugach Electric seeks to anticipate the effect of electrification on its service and is keen to partner with major players like ANC early and often in the process, including by offering EV charging incentive programs to promote the use of EVs in Alaska.

E.2.1 Airports

Three airports were surveyed to learn more about their approach to EVs and EVSEs in public parking and RAC operations, as well as other contexts. The peer airports – Seattle-Tacoma International Airport (SEA), John Glenn Columbus International Airport (CMH), and Indianapolis International Airport (IND)-were selected for commonalities with ANC (e.g., size, origin and destination travel volume, market, etc.). At the same time, it is important to recognize that ANC is unique, and electrification planning at the airport must be tailored to its distinctive characteristics.

An Airport Like No Other

In 2022, ANC was the 3rd busiest air cargo airport. It is co-located with the world's busiest floatplane facility and is the busiest float plane seaplane operation in the world. As the largest airport in Alaska, ANC provides one in seven jobs to the Anchorage metropolitan area with an annual economic impact of $1.84 billion (USD) to the state (Crook, 2023).

SEA, CMH, and IND are all currently engaged in discussions with RACs to develop EVSE. A description of the various stages of EVSE planning and deployment is as follows:

- **SEA**: There are currently 18 Level 1 charging stations at SEA on the first floor of the parking garage and 94 Level 2 charging stations that are used by both the airport fleet and for personal use by employees. There are Direct Current Fast Chargers (DCFC) in SEA's cell phone lot.
- **CMH**: There is one Level 2 dual port charging station in the valet lot; however, it is not used due to accessibility issues. The newly expanded parking garage includes 10 Level 2 dual port charging stations that allow for 20 cars to charge. There is also one Level 2 charging station in the "walking lot," one in the employee lot, and three DCFC for the electric buses that serve ConRAC facility.
- **IND**: The airport currently owns and operates 84 EV chargers, all of which are Siemons-based brands. There are 35 Level 2 charging stations, four Level 3 charging stations in the parking garage, and 10 Level 2 charging stations in the valet station.

E.2.1.1 Seattle-Tacoma International Airport (SEA)

Sustainability goals, including reducing greenhouse gas emissions, are the biggest drivers for increasing the amount of EVSE within parking operations at the SEA.

SEA does not currently track EVSE usage data. However, they expressed interest in exploring data tracking in the future with the aim of monetizing the use of chargers. Fees for utilizing the Level 2 charging stations in the parking garage are currently included in the rates for occupying a parking spot. SEA aims to separate these costs so that users can simply pay for parking without any costs related to EVs in the future. The airport is currently operating a cost recovery system and is transitioning towards a paid system for the Level 2 chargers located in the north employee parking lot. SEA aims to implement a charging fee, as the current costs are distributed among all individuals parking in the lot regardless of their EVSE use.

SEA currently partners with EVGo, which sets its own rate for the use of charging stations in the Cell Phone Lot and is billed as a tenant for electricity usage. EVGo chargers are the only fast chargers at the airport and are highly utilized. EVGo performs maintenance on charging stations in the Cell Phone Lot. SEA is exploring a more comprehensive maintenance strategy across the entire airport.

The airport is engaging in a planning effort with all its RACs about installing chargers at its rental car facility. SEA is advancing the installation of Level 2 chargers within RAC operations, which are being paid for through a tenant reimbursement project by RAC companies. The design was 60% complete as of May 2024, with an expectation that installation will begin in the next few months. RAC companies operating at the airport are pushing SEA to support 85% EV utilization by 2026. However, introducing additional electrical capacity to fully meet their desired requirements is complicated and expensive. The airport is currently working with a commercial management team to allocate costs for equipment and increase electric capacity at the facility.

Alaska Airlines has invested in a generator farm at SEA to support their operational equipment requiring backup generators. Presently, the airport's usage ranges between 14 and 15 megawatts (usage at ANC is currently around 3.6 megawatts). The backup facility is currently diesel-powered; however, the airport is actively developing strategies to decarbonize and minimize its environmental footprint. Exploring more resilient infrastructure with improved storage, including hydrogen as a long-term strategy, is being considered. SEA aims to reduce reliance on additional diesel resources and is identifying what is considered ‘mission critical,’ to be connected to the backup power systems in the case of an emergency.

Notable challenges that SEA has encountered include the cost and effort to increase electrical capacity, and there is no strategy currently in place to implement infrastructure upgrades to meet increasing demand. Additionally, space constraints at SEA pose challenges for EVSE implementation. While the demand for charging equipment is immediate, the full infrastructure development might extend over the next 10 years. However, the rate of change is dramatic for

EVSE infrastructure, and it is likely that charging technology will need to be updated before the end of its operational life.

SEA is interested in electrifying their ground support equipment (GSE) and installing airfield chargers in addition to 14 Level 2 chargers in the parking garage and two DCFC chargers for use by police vehicles. They are also installing 10 DCFCs (five dual-port units) in the TNC and taxi holding lots, potentially accounting for 10% of the airport's peak electricity demand. Additionally, five DCFCs (four dual-port 350 Kilowatt-hours [kWh] chargers and one dual-port 100 kWh charger) are being added via a public grant from the Washington State Department of Commerce.

E.2.1.2 John Glenn Columbus International Airport (CMH)

All EV charging stations at CMH are the ChargePoint brand and were financed and installed using a combination of grants by the state of Ohio, the Volkswagen Settlement grant, and the electric company that supplies electricity to the airport (AEP Ohio). ChargePoint performs maintenance on the charging stations.

There is currently one single pedestal charging station with dual ports in the valet parking area. However, utilization is low due to accessibility issues, as valet parking was still discontinued as of May 2024 due to COVID but may be restarted in the future. The parking garage previously had one dual-port Level 2 charger located on the fourth floor. However, the recently expanded and remodeled parking garage included the addition of 10 dual port charging stations that allow for 20 cars to charge. There is also one dual port charging pedestal in the “walking lot,” as well as one in the employee lot.

Utilization of EVSE is high at CMH. Overall parking occupancy rates in parking lots have returned to pre-COVID volumes. The airport conducts assessments of parking durations in various lots to determine the most suitable charger types, opting primarily for Level 2 chargers due to their widespread commercial availability, durability, and convenience for users to locate them online. CMH reports that most parking spots in the parking garage with a charger are being utilized.

Collecting fees for electricity in Ohio is limited to public utilities and many EVSE grants mandate that chargers be publicly accessible. Therefore, customers using the parking garage/lot pay the same rate, regardless of EV charging. CMH is exploring strategies to mitigate overall peak demand in the future. This would lower overall costs as electricity costs are influenced by peak demand.

Previously, the RACs occupied space in the parking garage until it was reclaimed by the airport. A collective fund was established by the RAC organizations to construct a new facility. Unfortunately, the building construction coincided with the COVID pandemic when ConRAC usage was low. At that time, the car rental companies did not anticipate a significant market for EVs in Ohio, leading them to decide against installing EV chargers in the facility. Hertz began purchasing EVs with operations returning to normal which prompted other RACs to follow suit.

Consequently, the building had to be retrofitted to include Level 2 EV chargers, with the costs covered by the RACs.

A low percentage of the internal fleet at CMH is EV; however, the airport is continuously evaluating eligible vehicles for use at the airport, including for the maintenance department and the police fleet. CMH Parking Operations considers EVs for courtesy cars but finds their performance unsatisfactory. Additionally, hybrid or all-electric public shuttles were explored but not adopted due to range limitations and insufficient heavy-duty capabilities. The airport utilizes two hybrid electric Ford fleet vehicles. In addition, CMH owns and operates three fully electric buses that serve the rental car facility and are charged using three DC fast chargers. Two of the charging stations are pedestal mounted. The third is suspended and attaches to the top of the bus.

A city ordinance requires that a certain percentage of all new public parking must contain chargers. CMH is in the process of replacing a passenger terminal, currently at 30%-50% design completion, with expected occupancy in 2028. As part of this project, a parking garage is anticipated to require approximately 100 additional EV charging spaces. While the charging configuration is not finalized, the airport is considering the construction of a substation with an estimated connected load approximately five times the typical requirement. It is anticipated that half of this load will be utilized on a standard day.

An emergency generator currently supports the parking garage, although it does not cover the entire load. CMH has a history of reliable electricity, with no significant or prolonged power outages. The Airport aims to implement onsite storage solutions to retain energy for emergency situations.

Along with increasing the electric capacity in certain areas of the airport, challenges reported by CMH include identifying secure and safe locations for charging stations, as EV fires require specialized firefighting techniques. There is hesitancy among operators to adopt electric GSE, fearing potential disruptions due to the equipment running out of power. CMH emphasizes the importance of having a clear purpose for investing in EVSE to ensure a well-designed system with dedicated ownership.

E.2.1.3 Indianapolis International Airport (IND)

There are currently 84 EV chargers overall, all of which are Siemens brands and are owned and operated by the Airport. Thirty-five Level 2 chargers and four Level 3 chargers, serving a total of 6,000 parking spaces, are presently in the public parking garage. Additionally, 21 Level 2 chargers and four Level 3 chargers are in the process of being installed. The valet area features an additional 10 Level 2 chargers. IND is installing EVSE for ground support equipment and has plans to deploy EV chargers in the cell phone lot and the rideshare (Uber/Lyft) lot.

Approximately 1% of the parking garage is equipped with EV charging infrastructure, with a goal to increase this to 2% across all parking facilities. The Airport currently has ongoing plans to

develop EV infrastructure for surface parking and expand EVSE at the Airport overall. The Airport is also using its second generation of electric buses to shuttle passengers from parking locations to the terminal.

IND initially installed 14 Level 2 charging stations in the parking garage that experienced high utilization. However, some of the occupancy may be due to the preferential location of these spaces at the front of the garage, and not all EVs occupying the spots are plugged in. There is also an indication that rental car companies are rotating cars through these spaces for charging. The airport expects significant usage from the newly installed chargers, though they might not reach the levels seen during the first installation of chargers. IND tracks parking facility usage and duration. However, they intend to employ a more aggressive tracking strategy to inform future planning and development. IND does not charge separately for the use of existing charging infrastructure outside of general parking fees. Currently, the use of chargers is considered customer service and an incentive to use EVs.

The RAC ready/return area is situated on the lower level of the parking garage, while the Quick Turn Around (QTA) area is in an adjacent building. The RAC ready/return area itself lacks chargers specifically designated for rental car use. Ongoing projects involve Hertz and Avis installing a total of 15 charging stations in the QTA building, with RAC operators expressing further interest in placing chargers for their use within the parking garage. With an upcoming expansion of the parking garage, the first floor will be reassigned for RAC use. In consideration of potential infrastructure changes due to future expansions, the RAC operators made the decision not to install chargers that might need to be abandoned or relocated.

The RACs operate on a separate electrical service for EVSE, shared through an RAC consortium. Anticipating a second parking garage expansion, the RACs plan to collect a Customer Facility Charge (CFC) for EV funding. The airport will maintain a separate electricity meter to facilitate billing for electricity usage which simplifies the process for RACs to track and allocate costs based on their individual electricity consumption.

An airport tech shop representative is dispatched to investigate reported issues with chargers marked as nonfunctional or experiencing difficulties. The services of a third-party representative are enlisted for the necessary repairs in instances of malfunction or damage.

The parking garage is equipped with backup power and emergency. Ongoing sustainability efforts involve the installation of renewable energy sources, including battery backup. Additionally, the introduction of microgrid controllers is underway which utilize renewable energy sources during the day and transitions to battery operation at night without disconnecting from the electricity grid or emergency backup systems.

Results from surveys of SEA, CMH, and IND compared to ANC are summarized in **Table E-5**.

Table E-5
Current EVSE Status at ANC and Benchmark Airports

Current Status	ANC	SEA	CMH	IND
EVSE in Public Parking?	No	Yes	Yes	Yes
EVSE in RAC Operations?	No	Yes	Yes	Yes
EVSE for Airport Vehicle Fleet?	No	Yes	Yes	No
EVSE for Other Applications (e.g., GSE)	No	No	Yes	Yes
EVSE Owned by Airport?	No	Yes	Yes	Yes
EVSE Operated by Airport?	No	Yes	Yes	Yes
EVSE Fees for Use?	No	Yes	No	No
EVSE Fees for Use in the Future?	No	Yes	Yes	No
EVSE Data is Tracked?	No	No	No	No

Source: RS&H Analysis, 2024

E.2.2 Rent-A-Car Companies (RACs)

The RAC operators at ANC consist of five airport concessionaire entities doing business as nine different brands. All RAC entities are Alaskan-owned and operated separately from national corporate brand entities. The largest RACs at ANC were surveyed or interviewed for this study to understand their EV and EVSE plans and perspectives. All are actively engaged in planning for EVs and EVSE and are forecasting steady growth.

E.2.3 Chugach Electric

Representatives from Chugach Electric, the utility provider for ANC, were interviewed to understand their perspective on the electrification of parking and RAC operations at the Airport. EV growth in Anchorage is the fastest in the state. Chugach Energy is actively supporting this surge through a strategic approach centered on establishing predictable rate structures tailored for EVs. Chugach introduced a tariff encompassing both Level 2 and Level 3 chargers in a recent initiative aimed at reducing overall operational costs. In addition, they implement incentive programs specifically designed to alleviate capital cost barriers associated with EV charging, such as providing discounts for charging stations depending on how projects are funded.

There is significant electrical demand associated with RACs, and conventional utilities often register peak usage during such operations, passing on a share of the cost to customers. Chugach develops an EV rate that blends demand and energy costs in response to the potential sharp peaks associated with RAC operations which aims for equitable and predictable EV energy costs.

Rental car demand at ANC is concentrated in the summer. Chugach recommends a consolidated hub near, but distinct from, ConRAC facilities that also serves the public to address ANC rental car demand peaking characteristics. The hub would introduce the potential for increased collaboration among partners and enable the sharing of associated costs.

Other key considerations highlighted by Chugach include:

- **Climate**: It is imperative to ensure that all equipment is appropriately rated for the environmental conditions at ANC and is equipped with adequate cover to withstand the impacts of the weather.
- **Implementation**: Chugach recommends a phased approach for ANC, starting with the update of metering equipment to accommodate a dedicated EV service rate. They advise against deploying all chargers simultaneously, emphasizing the importance of early and frequent communication between Chugach and the Airport, and a gradual implementation to accommodate the rapid evolution of vehicles and technologies.
- **Infrastructure**: The installation of EV infrastructure entails a complex process with various components, such as securing easements, and procuring and installing large and expensive transformers. The extended lead times associated with these processes present challenges in aligning timelines effectively.

Electric loads in Anchorage have declined over the last decade or two, resulting in a decline in available electrical capacity. Most areas are configured in a 'looped' manner, allowing them to be fed from multiple directions. However, predicting future loads is challenging, particularly given the seasonal fluctuations associated with Airport and RAC operations. The growth of EV adoption is anticipated to accelerate rapidly, potentially exceeding current estimates. Operators should be prepared for challenges associated with inexperienced users and rental car customers entering the EV landscape. An early development of a comprehensive design is critical, considering that Anchorage serves as the urban center in a state with unique challenges for EVSE. Anchorage cannot solely rely on statewide numbers to inform their EVSE implementation, emphasizing the need for a proactive and locally tailored approach to accommodate the expected surge in EV adoption.

E.3 EVs in ANC Parking Operations

ANC needs to increase its EVSE to 0.3% to 0.5% of parking spots in facilities by 2025 and 1.5% to 3.4% by 2035 based on forecasted penetration of EVs in the planning area and occupancy patterns in parking facilities. Expanded EVSE will require upgrades to the airport's electric infrastructure and utility service. Maintaining a robust EVSE network at the airport can be supported by obtaining grants and charging a competitive fee for use.

E.3.1 Parking Operations

ANC operates three fee-based public parking facilities consisting of Short Term, Long Term, and Park-Ride & Fly parking facilities. ANC also operates a Cell Phone lot. These facilities provide a variety of parking amenities that meet travelers' needs, ranging from basic to premium. These parking facilities are briefly described in **Table E-6**.

Table E-6
ANC Public Parking Facility Summary

Facility	Description
Short Term Garage (South Terminal)	The Short Term Parking Garage is located east of the South Terminal. It includes an additional 1,235 spaces at a rate of $16 per day.
Long Term	The Long Term parking lot is located northeast of the Short Term Parking Garage. It currently accommodates 894 cars at a rate of $13 per day with a weekly maximum of $78.
Park Ride & Fly	The Park, Ride & Fly Lot is located on International Airport Road, adjacent to the Cell Phone Lot, and has an existing capacity of 291 paved parking spaces, with additional capacity for 100 vehicles in unpaved spaces. Parking costs are $9 per day.
Cell Phone	The Cell Phone Lot is utilized by motorists waiting for arriving airline passengers and TNC drivers waiting for requests for rides from customers. It is located on Rutan Place and Aviation Avenue. There are 15 parking spots available during the week, and more than 30 spots during the evening and weekends.
Employee	The Employee Lot is located on the northern boundary of the Long Term parking lot on International Airport Road.
Short Term Lot (North Terminal)	The Short Term Parking Lot is located east of the North Terminal and is underutilized due to a lack of scheduled international flights. It provides 207 parking spaces and has a rate of $13 per day with a weekly maximum of $78.

Source: Terminal Ground Access Study, 2020; RS&H Analysis, 2024

ANC has two terminal buildings, the North Terminal (international) and South Terminal(domestic), which service commercial airline flights. The North Terminal is underutilized, with very little passenger traffic and nearly zero demand for roadways, curbsides, or parking facilities. The primary lots used at ANC are the Short Term Garage, Long Term Parking, and the Park-Ride & Fly lot.

Figure E-7 shows the locations of ANC's fee-based parking services. The Cell Phone lot is located immediately south of the Park, Ride & Fly lot both are located further from the terminal down International Airport Road. Employee, Long Term, Short Term Garage, and Rentar Car Center lots are located adjacent to the South Terminal, which primarily services Domestic flights. The Short Term Lot is located adjacent to the North Terminal, which services international flights.

Figure E-7
ANC Parking Facilities Locations

Source: ANC Airport Website

E.3.2 Parking Facility Use

Data provided by ANC characterizes the use of the Airport's public parking facilities. Data include capacity, occupancy, and duration of occupancy from 2021 through 2023. As expected, facility use characteristics differ based on the parking service.

Close to 80% of parking activity occurs in the Short Term Garage and Long Term Lot. An average of 2% of parking activity occurs in the North Terminal Short Term Lot, and around 19% of parking occurs in the Park, Ride & Fly Lot. The occupancy and duration of the Cell Phone and Employee lots are not tracked. Based on the typical use patterns of these lots, it can be assumed that the typical duration within the Cell Phone Lot ranges under one hour, and the duration within the Employee lot is concurrent with a typical working shift (up to 12 hours).

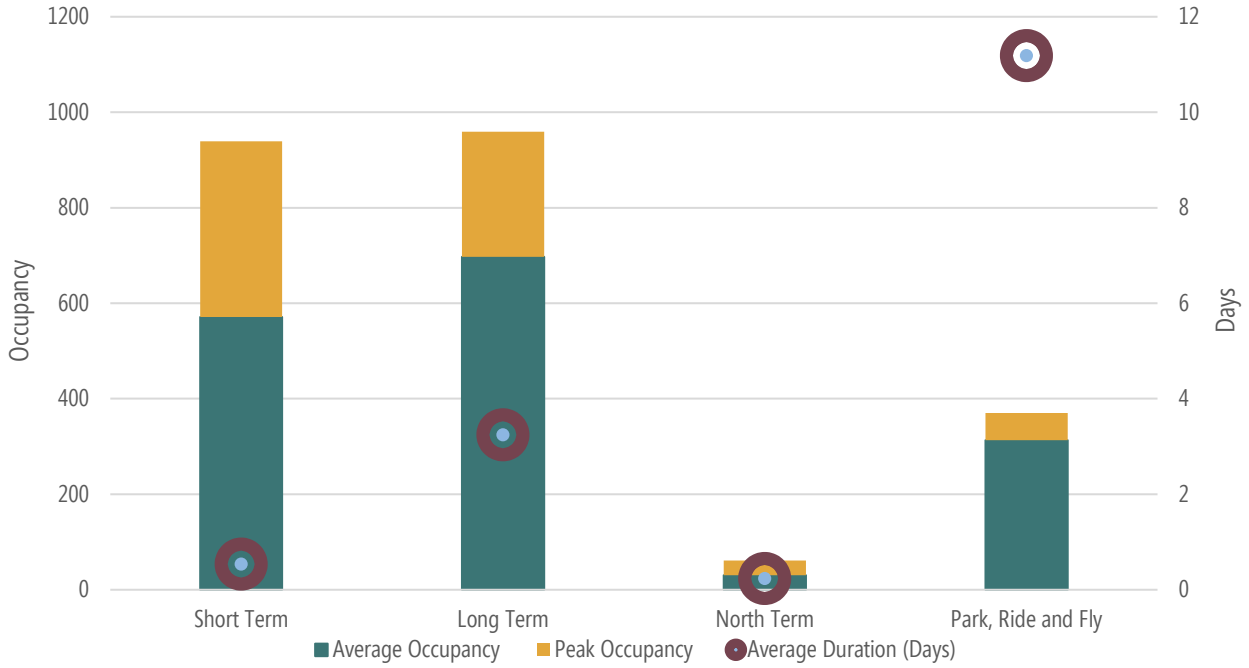
ANC's parking facility operational characteristics are summarized in **Table E-7**. Parking occupancy (peak and average) and average duration for 2021 – 2023 is depicted in **Figure E-8**.

Table E-7
ANC Parking Facility and EVSE Summary

Facility	Capacity	Occupancy		Duration (Days)	EVSE
		Peak	Average		
Short Term Garage (South Terminal)	1,379	939	571	0.5	0
Long Term Lot	894	959	697	3.2	0
Park, Ride, & Fly	291	330	313	11.2	0
Short Term Lot (North Terminal)	207	61	30	0.2	0

Source: RS&H Analysis, 2024

Figure E-8
Public Parking Facility Occupancy, 2021-2023



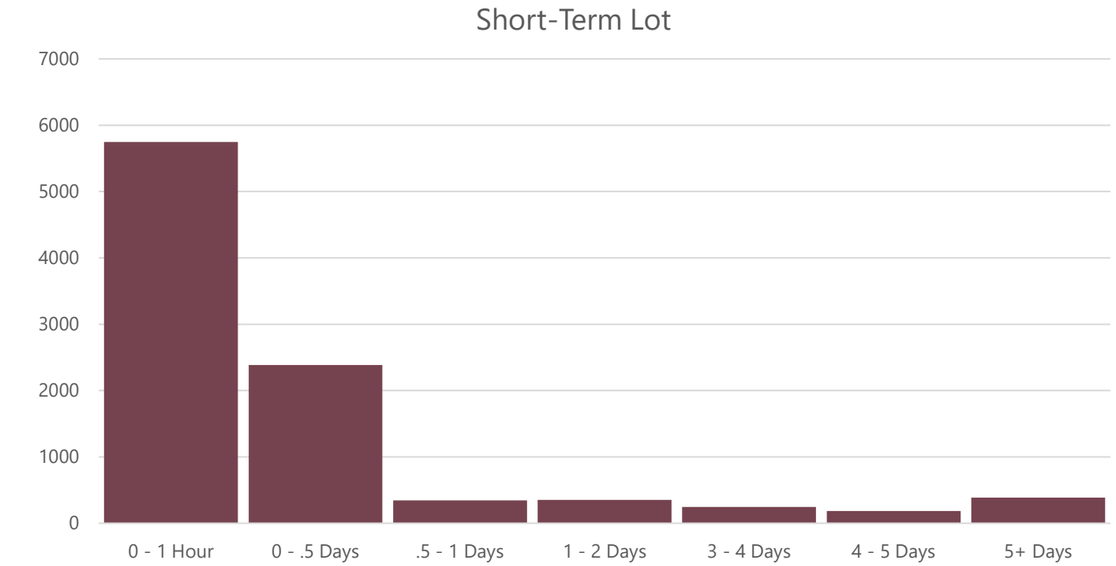
Source: RS&H Analysis, 2024

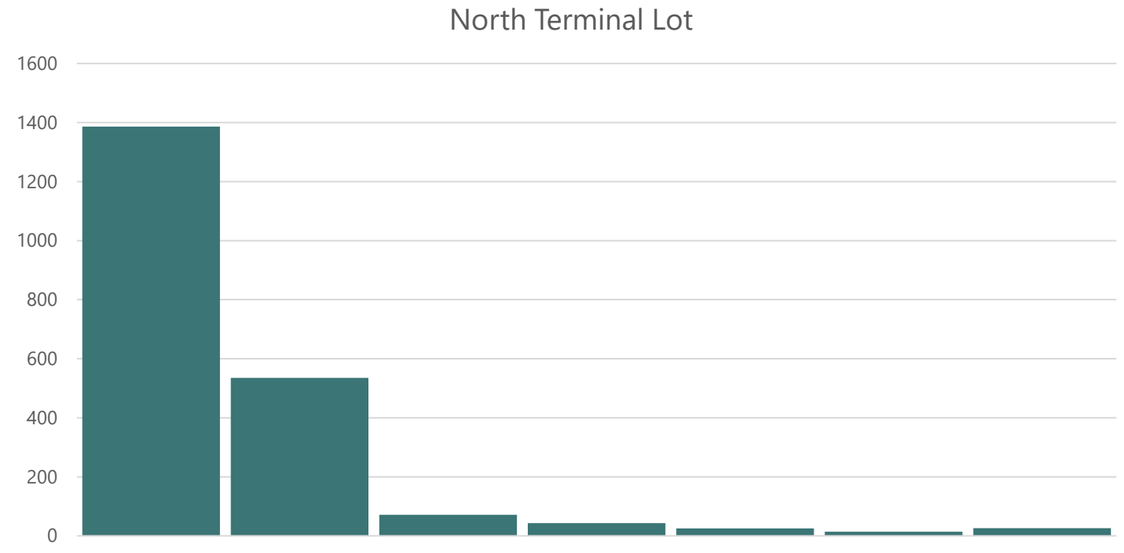
The occupancy duration frequency distribution for the major categories of each parking facility is depicted in **Figure E-9**. these graphs show that most users occupy facilities for less than one hour, except in the Park, Ride, and Fly facility, which is likely due to ANC's pricing structure which does not charge for the first hour of use. Around 40% of stays are less than 12 hours even in Long Term parking. The highest percentage of stays within the Long Term Lot are over five days, with 56% of stays being over one day. The Park, Ride, and Fly lot demands more long-term use, with over 80% of users staying five or more days.

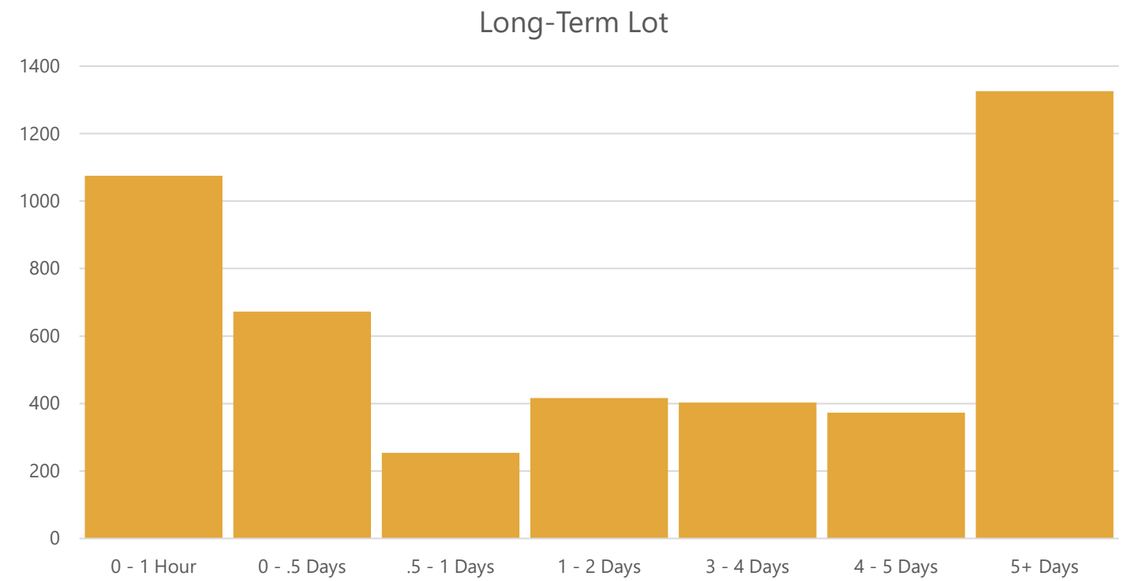
E.3.3 Existing Charging Stations

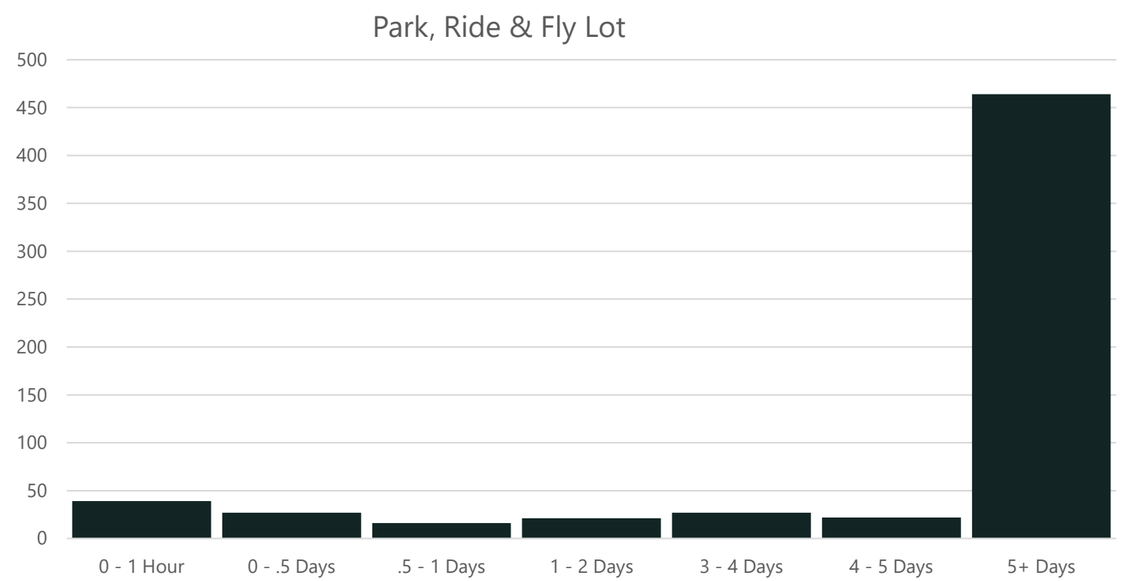
There are currently no EVSE charging stations installed at ANC.

Figure E-9
Occupancy Duration Frequencies by Facility









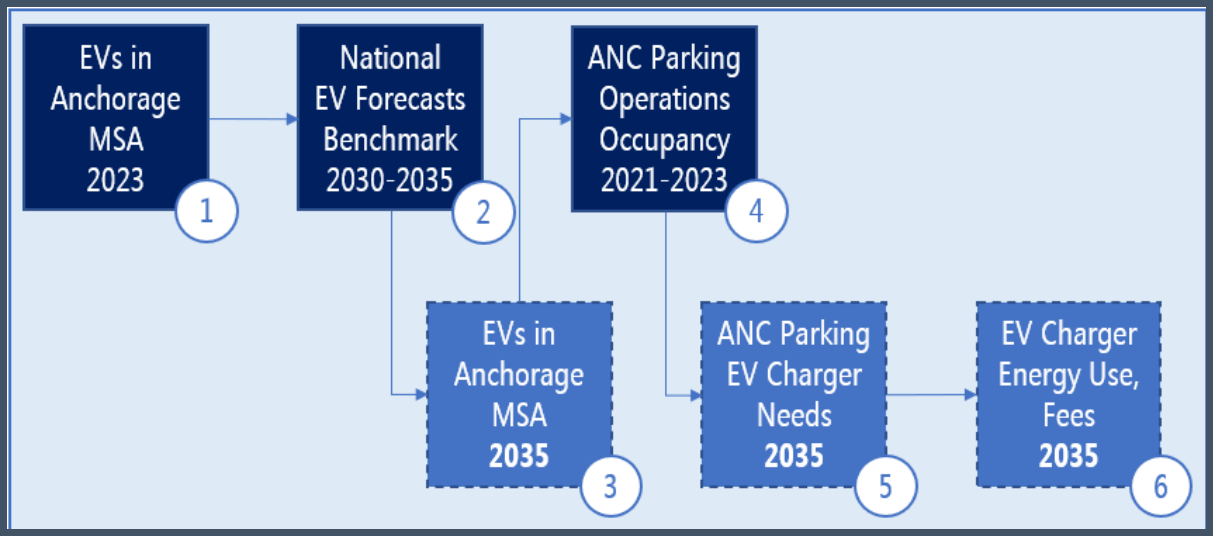
Source: RS&H Analysis, 2024.

E.3.4 Forecasted Needs

Forecast Methodology –

A forecast of future EVSE needs at ANC's public parking facilities was developed following six steps shown in **Figure E-10.**

Figure E-10
Methodology Summary for Forecasted EVSE Needs at ANC's Parking Facilities



1. EV market penetration in the Anchorage MSA was characterized for 2022 using data available from registrations within the state of Alaska.
2. National EV forecasts through 2030 to 2035 developed by a variety of private, government and NGO agencies were benchmarked to a common basis.
3. Benchmarked forecasts were downscaled to create a forecast for ANC's planning area through 2035. Three scenarios were developed: low, medium, high market penetration. The scenarios were based on the range of national EV forecasts.
4. ANC's parking operations occupancy statistics during peak months were evaluated, producing summaries of peak occupancy, average occupancy, and duration of occupancy by facility.

   Forecasted EV market penetration within the ANC planning area were applied to average occupancy values for each ANC parking facility through 2035 to estimate how many EVs might use facilities in the future. Peak rates were not used since in peak conditions, EV charging ports will remove capacity from ANC's facilities for non-EVs.

   The estimate assumes 2018-2022 parking occupancy rates remain constant through 2035. The estimate of EV charger needs assumed one port required for each forecasted EV.

The type of EV charger allocated to each facility was determined by occupancy patterns, with L1 chargers preferred where duration was greater than two days, L2 chargers preferred where the average duration was less than two. Figure 13 shows duration distributions for each lot, which were used to determine needs for fast and slow chargers. DCFC chargers were assigned to lots with a high frequency of durations of less than half a day, in combination with L2 chargers to accommodate for the high capital cost of DCFC.

6. Energy use (kWh) and energy demand (kW) were estimated based on the forecasted quantity of EV chargers and the EV charger specifications included in **Table A-8**. The estimate was calibrated to the expected utilization rate of EV chargers at ANC, which is expected to start at a low rate due to the lack of existing EVSE at the Airport. The utilization rate was then scaled up to reflect increased utilization until it reached a rate of 66% utilization.

All forecasts are limited by uncertainties related to demographics, economics, and technology, among many other factors. In addition, this forecast is subject to the following uncertainties that could affect the actual number of EV charging ports required in ANC parking facilities in the future:

- EV market penetration may proceed faster or slower than the benchmark projections.
- EV market penetration in the Anchorage MSA may be significantly different than the national rate.
- The rate at which EVs penetrate the Anchorage MSA fleet may not be the same rate at which EVs occupy ANC's parking operations.
- The occupancy and/or duration of stay in ANC's parking facilities may change significantly.
- EV driver demand for EV charging may be lower than expected (e.g., the State of Charge of the average EV user may be much higher than 63% and thus they will have no need to charge their vehicle).
- EV charging technology may change in unforeseen ways that affect applicability of L1, L2, and DCFC chargers to ANC's parking facilities.
- Utilization rates of EVSE at ANC may be significantly different than predicted, depending on actual use.

ANC needs between about 37 and 91 charging ports in its parking facilities by 2035 based on forecasted market penetration of EVs in the ANC planning area and occupancy patterns in ANC parking facilities. The needs amount to 0.3% to 0.5% of total parking spots across all facilities in 2025, growing to 1.5% to 3.4% in 2035. In 2024, the forecast calls for two to four new L1 chargers, one new L2 charger, and no DCFC chargers.

Vehicles in the Park, Ride, and Fly lot stay for over five days, making L1 chargers the most preferred. L1 chargers also have the lowest capital and operating costs. A large portion of parking users among the rest of the parking lots park for less than one day, making L2 or DCFC preferred. The Short Term and North Terminal lots are best suited for L2 chargers and a few DCFC, considering the capital cost of installation and O&M for DCFC. A small number of L2 chargers may be needed in the Long Term lot to serve a few passengers who occupy the garage for less than two days. Otherwise, the Long Term lot is best serviced by L1 chargers since many occupants stay for over five days.

The occupancy and duration of the employee lot are not tracked, but due to the nature of airport working shifts, it is assumed that the lot can be serviced primarily by a mixture of L1 and L2 chargers. The cell phone lot also does not track occupancy and duration. THIS parking lot would be best served by DCFC given the short time span a vehicle typically spends in a cell-phone lot. However, it should be evaluated whether the capital cost of installing a DCFC would be justified in this situation. Vehicles are unlikely to plan to charge their EV at the airport if they are only picking up or dropping off a passenger.

EV charger needs in 2025, 2030 and 2035 by parking facility for low, medium, and high scenarios are described in **Table E-8.**

Table E-8
Forecasted EV Chargers by Facility for Low, Medium and High Scenarios

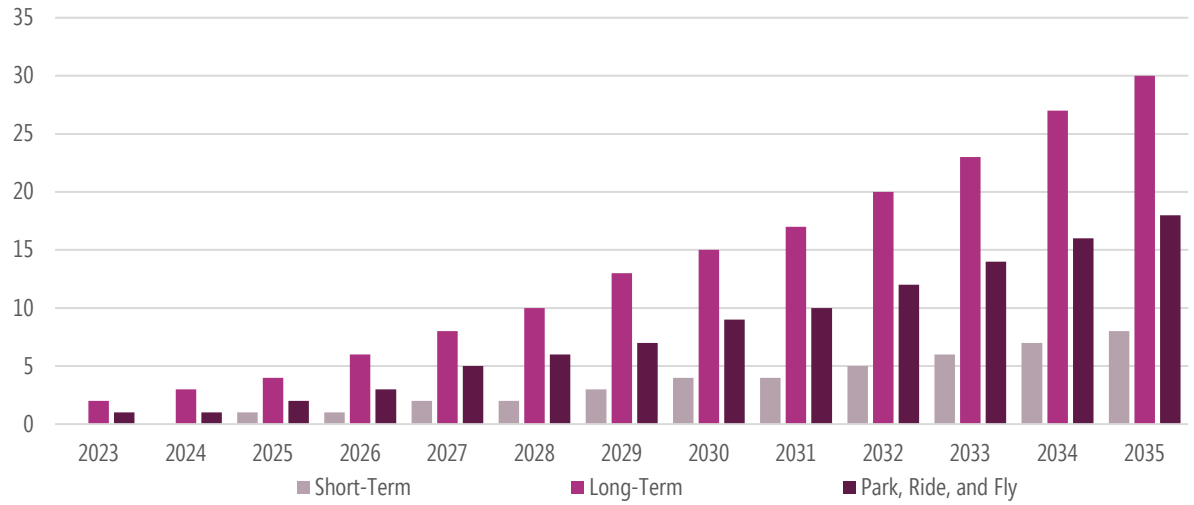
Year & Facility	DCFC-Low	L2-Low	L1- Low	DCFC-Med	L2-Med	L1-Med	DCFC-High	L2-High	L1-High
2025	**0**	**1**	**3**	**0**	**2**	**4**	**1**	**3**	**7**
Short Term	0	1	0	0	1	0	1	2	1
Long Term	0	0	2	0	1	3	0	1	4
North Terminal	0	0	0	0	0	0	0	0	0
Park, Ride, and Fly	0	0	1	0	0	1	0	0	2
2030	**1**	**5**	**11**	**2**	**8**	**16**	**4**	**13**	**28**
Short Term	1	3	1	2	5	2	4	8	4
Long Term	0	2	6	0	3	9	0	5	15
North Terminal	0	0	0	0	0	0	0	0	0
Park, Ride, and Fly	0	0	4	0	0	5	0	0	9
2035	**3**	**11**	**23**	**5**	**16**	**35**	**8**	**27**	**56**
Short Term	3	7	3	5	10	5	8	16	8
Long Term	0	4	13	0	6	19	0	10	30
North Terminal	0	0	0	0	0	0	0	1	0
Park, Ride, and Fly	0	0	7	0	0	11	0	0	18

Source: RS&H Analysis, 2024.

E.3.4.1 L1 Charge Port Forecast

L1 charger port needs range from about 23 (low scenario) to over 56 units (high scenario) by 2035. L1 charger needs in Short Term, Long Term, and Park, Ride, and Fly facilities between 2023 and 2035 are shown below in **Figure E-11** for a *medium scenario*. L1 chargers were not allocated to other facilities.

Figure E-11
L1 Charger Forecast by ANC Parking Facility, 2023 – 2035, Medium Scenario

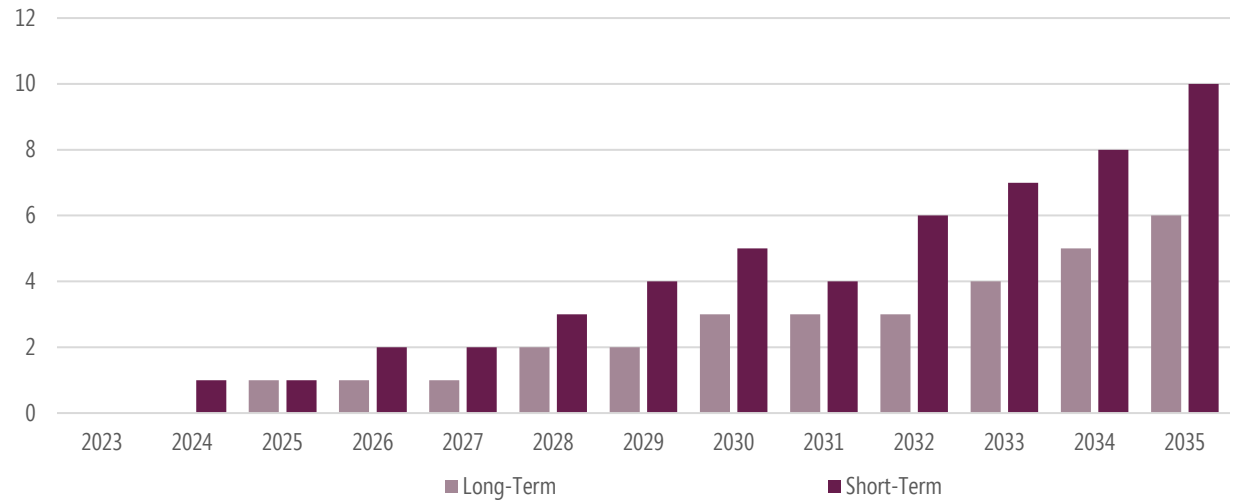


Source: RS&H Analysis, 2024.

E.3.4.2 L2 Charge Port Forecast

L2 charger port needs range from about 11 (low scenario) to 27 (high scenario) units by 2035. L2 charger needs in the Long Term and Short Term facilities between 2023 and 2035 are shown below in **Figure E-12** for a *medium scenario*. L2 chargers were not allocated to other facilities.

Figure E-12
L2 Charger Forecast by ANC Parking Facility, 2023 – 2035, Medium Scenario

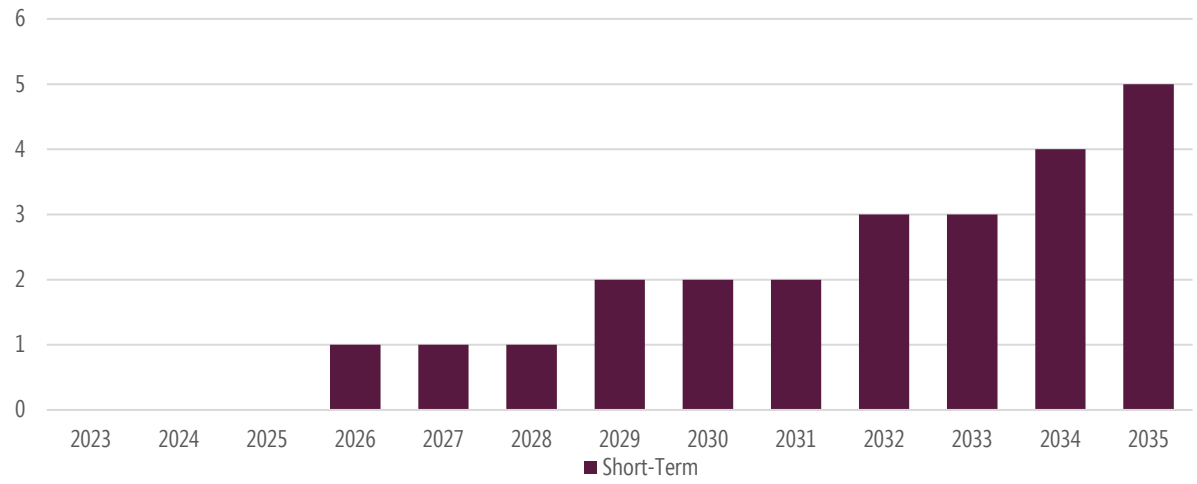


Source: RS&H Analysis, 2024.

E.3.4.3 DCFC Charge Port Forecast

DCFC port needs range from about three (low scenario) to eight (high scenario) units by 2035. DCFC chargers in the Short Term facility between 2023 and 2035 are shown below in **Figure E-13** for a *medium scenario*. Chargers are not allocated to other facilities, such as the Cell Phone lot, since it is not part of ANC's revenue generating facilities. Data suggest average occupancy in the Cell Phone lot is low and occurs for very short durations. Under certain circumstances, one or more DCFC chargers may be appropriate, but it is not financially justifiable given the cost of a DCFC.

Figure E-13
DCFC Charger Forecast by ANC Parking Facility, 2023 – 2035, Medium Scenario



Source: RS&H Analysis, 2024.

E.3.4.4 Energy and Power Needs

Planning for the associated energy consumption and power demand is also an important factor to consider. Expanded EVSE will require upgrades to the airport's electric infrastructure and potentially the electric service provided by Chugach Electric. These upgrades can be time-consuming and costly, underscoring the need to design and operate EVSE to minimize energy and power requirements.

Potential energy use and power demand scenarios are summarized in **Table E-9**.

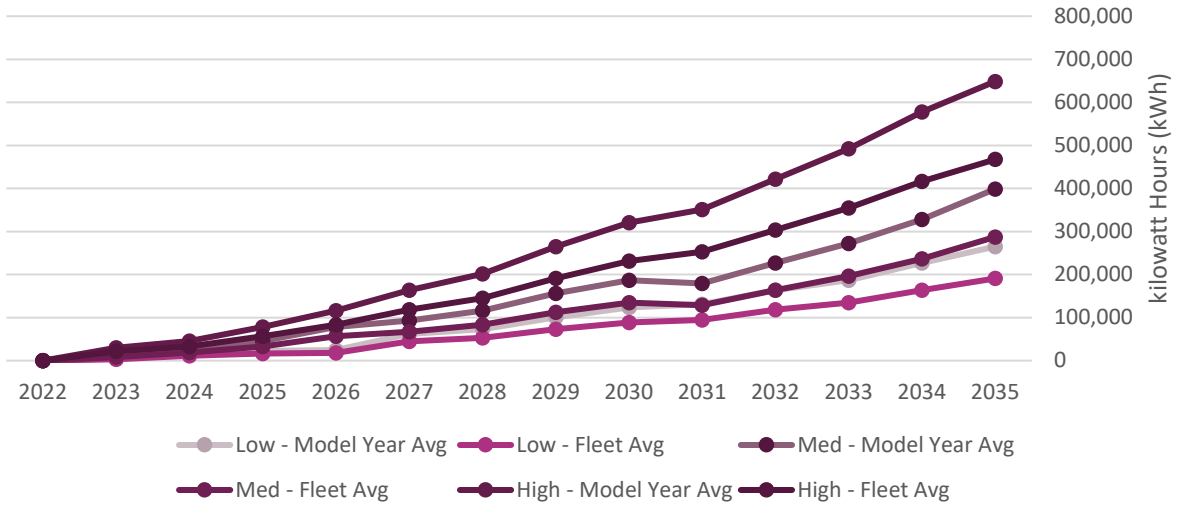
Table E-9
Forecast Energy Use (MWh) and Power Demand (MW) in 2025, 2030, and 2035.

Year	Low		Med		High	
	Use (MWh)	Demand (MW)	Use (MWh)	Demand (MW)	Use (MWh)	Demand (MW)
2025	16	0.0	39	0.0	78	0.1
2030	89	0.1	161	0.2	321	0.4
2035	191	0.3	343	0.4	649	0.7

Source: RS&H Analysis, 2024.

Potential energy consumption scenarios from 2023 to 2035 are depicted in **Figure E-14**. The scenarios consider low, medium, and high EV market penetration, as well as increasing EV battery capacity from today's fleet average to the 2022 model year average.

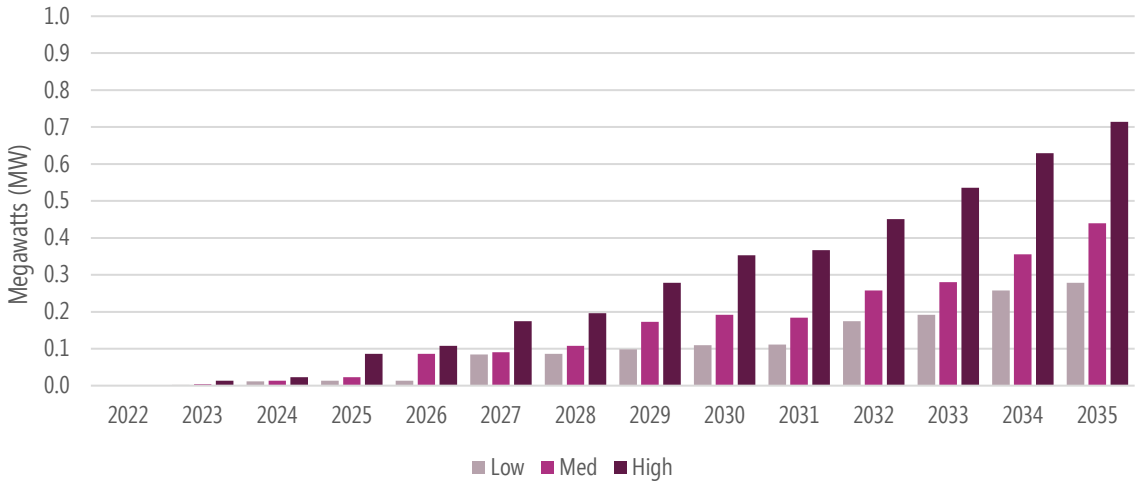
Figure E-14
Forecast Energy Use (kWh) Scenarios, 2023 – 2035



Source: RS&H Analysis, 2024.

Supplying energy to EV charging ports requires power supply infrastructure expansion. The power demand of EV charging ports, measured in Kilowatt-hours (kWh) or Megawatt-hours (MWh) ("demand"), is a reliable proxy for planning ANC's power requirements. The 0.7 MW forecasted in the 2035 high scenario, as depicted in **Figure E-15**, is equivalent to the electric demand of 840 residential homes in a month. ANC currently uses approximately 3.6 MW annually, so by 2035 they could plan for a 20% increase in power demand due to passenger EV charging. Demand in the ConRAC adds to this increase. Costly upgrades to the utility infrastructure may affect ANC even though the operator or tenants at the ConRAC may be responsible for paying monthly utility charges.

Figure E-15
Forecast Power Demand (MW) Scenarios 2023 - 2035



Source: RS&H Analysis, 2024.

The 2025 scenario equates to about $2,800 to $13,400 of electricity consumption, while the 2035 scenario equates to about $40,000 to $137,000, assuming an average electric rate of $0.16 cents and an electricity inflation rate of 2.1% annually across the low and high scenarios, assuming stations are used no more than once per day. The actual cost will depend on the EVSE design, managed charging techniques, and the tariff negotiated with Chugach Electric.

E.3.5 EV Charging Rates

Establishing a rate for EV charging that results in high usage, while covering operating costs is a reasonable goal for ANC. Maintaining an effective rate depends on ANC gathering and evaluating accurate data on EV charger station use and operating costs. The wide availability of incentives, grants, and other support for EV charging capital costs will be key for reducing significant up-front costs.

ANC currently does not operate any EVSE charging stations, so there is no base rate from which to benchmark.

E.3.5.1 Industry Context

Approximately 75% of the nation's thirty busiest airports (measured by passenger volume) offer EV charging at no cost for patrons paying to park. Currently, only a few levy fees. Pricing strategies vary widely, including simply passing on the cost of electricity, elaborate fee structures designed to influence how long an EV is plugged in, as well as rates (typically set by concessionaires) that push the limits of what the market will bear. Fees can include charges for the energy used, charges by the hour, or flat fees for connecting to the service.

This variation suggests there is no "one-size-fits-all" approach to generating revenue from EV charging services. A pricing strategy must be the result of careful consideration of costs, customers, and competition, as well as larger strategic and sustainability goals.

E.3.5.2 Cost and Revenue Considerations

Capital costs to install EV chargers vary by type:

- **L1**: $1,500+
- **L2**: $5,500 to $15,000+
- **DCFC**: $30,000 - $200,000+

Costs include the charging equipment, electrical equipment, and labor. Electrical equipment and labor can vary significantly depending on the existing electrical service and the complexity of the installation. Economies of scale occur when installing many charging stations at one time. However, major electrical infrastructure upgrades are required as power demand crosses thresholds; further, the ability to "future-proof" infrastructure against technological change is limited when installing high quantities of infrastructure at any given time.

Recovering the capital cost of L1 chargers may be feasible; however, it is less likely for L2 and particularly DCFC chargers, given expected costs versus the limited revenue available.

Collecting enough revenue to manage operating costs is more reasonable and can be a key strategy to ensure the quality of EV charging services as they grow. Operational costs include

electricity, maintenance, and network fees. Maintenance and network fees are subject to contract negotiations under a concessionaire model. Network fees are also negotiable if operated by ANC. The following values reflect what may be an average range, using the assumptions detailed above (Forecast Methodology). They also depend on energy use, the number of charging sessions per station, and economies of scale per year. They could total $6 to $10 per session, or $0.50 - $0.70 per kilowatt-hour.

- **Electricity**: $3.5 to $5 per session (at $0.16 / kWh).
- **Maintenance**: $2,000 or more over a 10-year life or $1 to $2 per session ($0.04 - $0.09 / kWh)
- **Network**: $375 - $750 per year or $1.5 to $3 per session ($0.07 - $0.13 / kWh).

These costs are small on the scale of a handful of stations. However, these costs can quickly add up as charging infrastructure grows into hundreds of stations. Economies of scale could drive these operational costs down (e.g., maintenance, network fees); however, other factors such as electric capacity charges could become a bigger cost factor, especially for Level 3 chargers with high power demand.

Large profits from EV charging may be unrealistic. High returns on investment require high use, which depends on price, convenience, and quality. Accordingly, there is a limit to how much revenue can be generated from EV charging. Drivers expect EVs to be about three to four times cheaper than fueling an ICE vehicle when charging at home. EV charging prices that are close to or higher than gasoline (e.g., the high end of the values cited above) may not attract users without additional, compensating convenience and quality factors (e.g., valet service).

It is important to consider that since ANC does not currently offer any EV charging, rolling out EV chargers at no cost may attract more customers and encourage higher utilization rates. Introducing a fee-based method will be more successful as ANC begins to introduce more charging capabilities in future years when EV fleet size increases and demand is higher. Other EVSE operators within the State have noted that although grant money is very beneficial in the initial installment of charges, there is a lack of consistent operational capacity. Collecting fees for EV charging can help mitigate this issue and allow for sustained and operational charging infrastructure for many years.

E.4 EVs in Rental Car Operations

Three of the largest RACs at ANC representing all RAC operations, are surveyed, or interviewed to understand their EV and EVSE plans and perspectives. These RACs request anonymity in exchange for information used in this analysis. These companies all acknowledge that electrification will require significant infrastructure improvements at ANC though they do not currently operate EVs at ANC.

Consolidated RAC operations are located within walking distance of the Airport terminal and include a multi-level QTA area where vehicles are fueled, which includes a lobby and four parking floors. The facility is 500,000 square feet, with 12 car washes, 16 fueling positions, and space for 1,200 rental cars.

E.4.1 RAC EV Forecast

Reasons for adding EVs to RAC fleets include corporate and government policy, and automakers' goals to shift production. RACs are approaching integration of EVs with a careful and systematic strategy, and adoption in Alaska is expected to be slower than the national market.

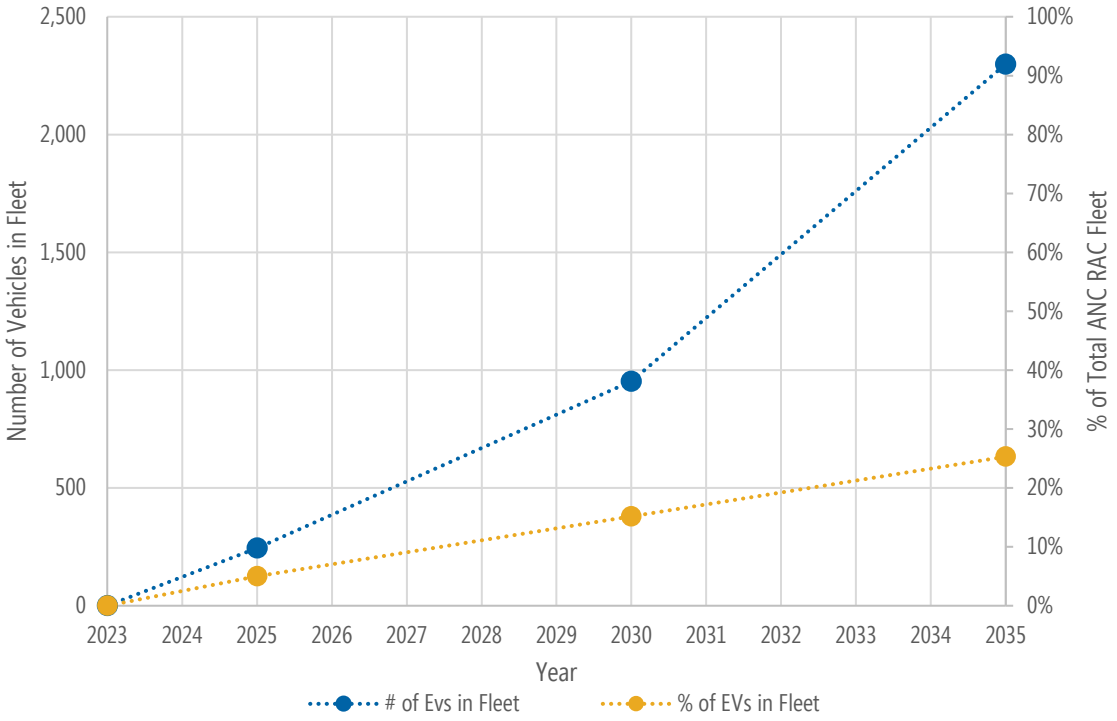
Presently, RACs agree that there is limited customer demand for EVs at ANC. About half of the total Anchorage market demand is from tourist travel during the summer months. There is pressure from the manufacturers and the government to adopt more EVs; however, the EV infrastructure in Alaska may not yet be robust enough to instill confidence in customers. Incremental cost challenges, including higher prices to purchase and maintain EVs, have also been a barrier to growth for RACs who have invested in EVs elsewhere in the US.

All RACs anticipate a future need for EVs at ANC. Further, as much as 40% of RAC fleets are replaced each year with fleet planning occurring over a one-to-two-year horizon, so RAC operators have flexibility to add EVs to their fleet quickly. In addition, automakers are encouraging EV sales by offering incentives to RACs.

Forecasts for EV growth among RACs vary significantly. Once RAC includes EVs as an unknown percentage of overall annual fleet growth of 10-15%, manufacturers' incentives significantly influence vehicle purchases. Another aims to electrify 5% of the fleet by 2025 and increase it to at least 10% by 2030. A third RAC has estimated the industry's power requirements upon reaching 25% EV penetration by 2030 and, upon this basis, has established goals for power availability, which it has shared with the Airport. This assessment was based on a comprehensive assessment of various factors, such as battery sizes in vehicles, charging states, turnaround times for rentals, peak return periods, and the efficiency of the charging process.

The present number of EVs in the ANC RAC fleet with projections for 2025, 2030, and 2035 based on consolidated survey data is depicted in **Figure E-16**.

Figure E-16
Present and Forecasted RAC EV Fleet and Percent of RAC EV Fleet



Source: RS&H Analysis, 2024.

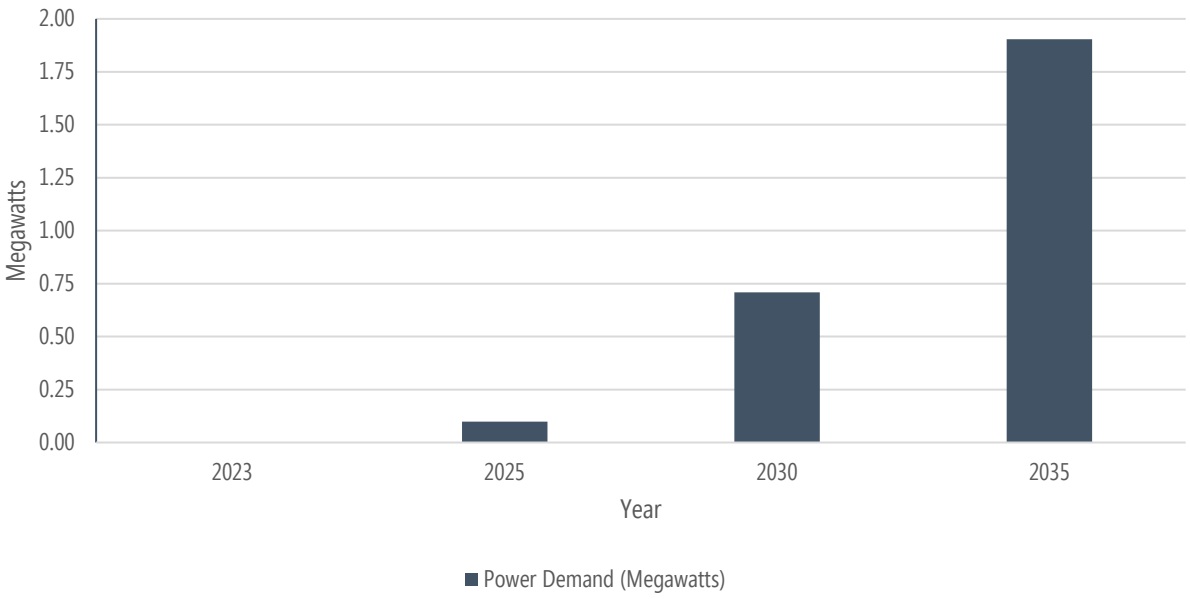
E.4.2 RAC EVSE Requirements

RACs' "turnaround time" from car return to rental is key to profitability and averages 25 minutes or less. RACs tend to prefer EVSE at multiple locations and with very high power (e.g., 150 kW or more[1]) to minimize increases in this interval. Further, while RACs strongly incentivize renters to return ICE vehicles with a full tank, they assume EV renters will not be able to do this due to the scarcity of EV chargers along roadways. They currently assume vehicles will be returned at a 20% to 40% charge. It is possible that this outlook changes in the future as EVSE proliferates. If the level of charge upon return is higher in the future, then the electricity consumed by RACs would decrease. However, their power-demand requirements would remain similar. RAC requirements are focused on available peak power rather than the number of chargers as a result.

[1] The power that can be received by an EV is a limiting factor. Today, this limit averages about 50 kW, depending on the make and model. This limit is increasing rapidly as EV batteries become more powerful.

Future EVSE power demand in the ConRAC could be close to two megawatts by 2035 when considering the number of EVs projected by the RACs and their operational requirements. **Figure E-17** depicts the potential demand using average values derived from the RAC survey.

Figure E-17
Averaged Forecast Power Demand (Megawatts) based on RAC Survey



Source: RS&H Analysis, 2024.

Annual energy costs could be over $100,000 in 2025, rising to about $2.5 million in 2035 assuming an average electricity rate of $0.16 and an electricity inflation rate of 2.1%, annually. Values could be higher if average rates are affected by increasing demand charges. Efficient design, managed charging, and negotiating an appropriate tariff with Chugach Electric will be important factors in determining actual costs.

The forecasts RAC EV adoption, EVSE requirements, power, and energy demands are based on data provided by the RACs and are subject to similar methodological limitations noted above in relation to EVSE in ANC's public parking facilities.

E.4.2.1 Charging Location Preferences

The Airport has allocated space in the garage and QTA area for each RAC, with specific allocations expected to evolve over time. Addressing the challenge of equitable allocation of EVSE infrastructure and associated costs is a complex task amid changing market shares and fleet sizes, especially with space constraints in the fueling area. Reallocation efforts will need to consider floor sections without disrupting the fueling cycle.

RACs have various visions of how to implement EVSE within the existing ConRAC. One RAC is considering the strategic placement of DC fast chargers in the QTA area, along with Level 2 chargers in the Ready/Return and storage zones. This model prioritizes efficiency, minimizing additional movements to fuel EVs beyond the established processes. The faster RACs turn around rental cars, the fewer cars they need in their fleet to achieve the same rental capacity. Increases in the time to fuel EVs necessitate an increase in fleet size and staff.

Another RAC operator expressed a preference for a centralized hub shared among various RAC operators, mirroring the current model at ANC designed for refueling gas-powered vehicles. In this model, RAC operators each possess one of three gas pumps with a fleet of "runners" capable of swiftly swapping out cars. High-powered DCFCs would be supplemented for the purpose of charging EVs. This RAC operator noted the absence of a vacant area within the present ConRAC that could be repurposed for new EVSE infrastructure.

E.4.3 ConRAC Solutions

ConRAC Solutions, a nationwide provider of consolidated rent-a-car facilities and operator of ANC's ConRAC, shared valuable insights into the rental car industry trends at ANC. ConRAC Solutions suggested a phased development for EVSE and stressed the necessity of a reliable energy storage solution to buffer high power demands. Energy storage can be planned in conjunction with future energy needs and renewable energy initiatives. ConRAC Solutions integrates RAC preferences into their strategy, recognizing that EVSE growth must align with RAC interests. ConRAC Solutions is actively investigating energy efficiency, considering the costs associated with enhancing facility power, and exploring alternative sources of energy and storage solutions.

E.5 Additional EV Considerations

This study estimates potential electrification needs in ANC's parking and ConRAC operations. The next step is to design, construct, operate, and maintain EVSE. Further, ANC must consider the full scope of electrification needs at the airport, including other electric mobility applications.

E.5.1 Design, Construction, Operations, and Maintenance

The next step in planning EVSE in ANC's parking and ConRAC operations is to understand current facility conditions and begin evaluating the feasibility of installing EV chargers at specific locations, including associated conduits, conductors, junction boxes, etc. EV charger technologies should be evaluated and specified, including features for networking, data management, and "smart" controls. Evaluating the capacity of electrical infrastructure and the need for upgraded electrical panels, transformers, etc. is also necessary. Estimates of costs and available funding sources would also be timely, given unprecedented levels of state and federal (e.g., FAA) support for EVSE. Delivery methods and models of ownership and operation will also be important for ANC to consider.

The factors described in the following subsections are also important.

E.5.1.1 Managed Charging

EVSE design should integrate the latest managed charging techniques with options to expand at pace with technological advancements.

Managed charging refers to techniques that reduce EV charging power requirements. Reducing power needs can reduce infrastructure requirements and electricity costs. Managed charging relies on hardware, software, or a combination of both, to leverage the fact that all EVs in a parking lot do not need to be charged the same amount at the same time.

Current managed charging techniques either lower the power supply to all EV chargers on a circuit or charge EVs sequentially so that as charging is completed at one vehicle, it begins at another. Other applications for managed charging include scheduling charging to occur during "off-peak" hours or installing battery storage (potentially supplemented by solar power) that can "buffer" peaks in grid demand. Battery buffering could be particularly useful for limiting peak demand (and associated costs) in a ConRAC setting.

Rapid technological advance in EVs, EV chargers, the electric grid, and associated control systems will soon make it possible to vary power supply by port based on input from the user, EV state-of-charge, time of day, total demand, and other factors. Managed charging synergizes with Vehicle-to-Grid (V2G) technology, which would allow airports to charge EVs at night and then supply power to the grid during the day. In partnership with Chugach Electric, this has the potential to generate revenue for the airport.

E.5.1.2 Greenhouse Gas Emissions

ANC should monitor strategies to account for and potentially monetize the greenhouse gas emissions (GHGe) associated with EVSE.

GHGe is associated with ICE automobiles used by travelers, TNCs, Taxis, GSE (not owned by ANC), and aircraft are considered "Scope 3" emissions. Scope 3 emissions result from activities not under ANC's operational control but indirectly influenced by the airport. These emissions are not considered part of ANC's "footprint." However, if ANC owns and/or operates EVSE, then the electricity it purchases from Chugach Electric and dispenses to vehicles could be considered part of its footprint and significantly increase its responsibility for GHG emissions.

ANC's role providing EVSE would enable significant local air quality improvements and decarbonization of transportation, a valuable contribution to environmental goals. This value can be monetized by airports in California where a credit trading mechanism has been developed for clean fuels. Outside of California, there is potential to develop carbon credits from EVSE that could potentially offset ANC's emissions or provide a source of revenue.

E.5.1.3 Resilience

Electrification brings substantial sustainability benefits to ANC, but it also introduces new risks associated with power outages. Battery systems can store power on site for an emergency while also buffering power demand under peak conditions as noted during discussions with Chugach Electric. Mobile charging solutions can serve EVs stranded in a parking facility. In addition, ANC may need to consider expanding its backup generator capacity in a manner consistent with its sustainability goals.

E.5.1.4 On-site Renewable Energy

Synergies with EVSE should be considered as ANC develops strategies for on-site renewables. On-site renewable energy, coupled with battery storage, could offset growth in purchased electricity consumption from EVSE and enhance EVSE resilience while reducing emissions if developed cost-effectively.

E.5.1.5 Fire Protection

The National Fire Protection Association (NFPA) sets codes and standards for fire, electrical, and related hazards. The NFPA has determined that EV fires are less common and not inherently more dangerous than ICE vehicle fires. However, the techniques for responding to them are different. NFPA is spearheading training and education for emergency responders to safely respond to EV incidents. It is important to ensure that emergency responders have received the requisite training as more EVs populate ANC's parking facilities.

NFPA's National Electrical Code (NEC) establishes standards for EV charging stations, electrified truck parking spaces, and the impact of the EV charging infrastructure on power consumption and emergency response. The NFPA has updated its codes to increase requirements for fire protection in parking garages to adjust for the growth of EVs. The effect is to require a greater density of sprinkler system coverage. These requirements, as well as additional safety considerations, should be explicitly addressed as part of ANC's design requirements and during design charrettes. Commissioning should be used to ensure that EV safety is incorporated throughout the design process and is faithfully implemented via construction.

E.5.2 Other Electric Mobility Applications

Additional modes must be considered to understand the full picture of electric mobility at ANC. These include transportation network companies, taxis, ANC's vehicle fleet, ground service equipment, and aircraft. While detailed evaluation is beyond the scope of this study, the following sections characterize potential demand for EVs and EVSE. Further analysis is required to forecast the requirements of these modes and the consequences for airport operations.

E.5.2.1 Transportation Network Companies (TNC) and Taxis

ANC provides staging areas for both TNCs (Uber and Lyft) and taxis at both the North and South terminals. Uber and Lyft have committed to achieving full electrification by 2030, with Uber already incentivizing EV drivers. Notably, at ANC, TNCs conducting business face no obligation to acquire an ANC permit, incur fees, or contribute to Airport revenues. In contrast, taxicabs provided by Alaska Yellow Cab and Independent Taxi are currently operating without specific EV goals. The EVSE requirements of TNCs and Taxis are beyond the scope of this study however, given the short dwell times of both TNCs and Taxis in ANC's staging areas, DCFC EVSE is most appropriate.

E.5.2.2 ANC Fleet

Review of ANC-owned vehicles is beyond the scope of this analysis; however, it should be noted that there is near-term potential for ANC to increase the size of its EV. EVs currently remain mostly limited to light duty cars and trucks while automakers are rapidly adding EVs to their offerings. Electric buses are also widely available. Light duty vehicles with gasoline consumption of about 1,300 gallons per year can be cost-effectively transitioned to EVs, given current assumptions regarding fuel and capital costs.

Generous incentives for converting transit buses to EVs are available from several federal sources associated with the Bipartisan Infrastructure Law and the Inflation Reduction Act, which can make transitions to EVs cost-effective. FAA's Airport Improvement Program has targeted funding specifically to sustainability and resilience projects in 2023 and 2024, and several airports have used this funding to convert vehicles to EVs and install associated EVSE.

The type of EVSE required by ANC's fleet will depend on fleet vehicle duty cycles. L1 chargers will be inappropriate for most fleet vehicles. Vehicles with duty cycles lasting a portion of the day will be best served by L2 chargers. Vehicles with heavy duty cycles and specialty vehicles will require DCFC chargers. Further detailed assessment is necessary to validate the potential for EVs within the ANC fleet, along with the quantity, type, and location of EVSE.

E.5.2.3 Electric Ground Service Equipment

Many airlines, in partnership with airports, have electrified GSE, such as baggage tractors, aircraft tugs, forklifts, and belt loaders. Electric GSE (eGSE) is a relatively mature technology with more than 10% market penetration and funding support from the FAA. *ACRP 236: Preparing Your Airport for Electric Aircraft and Hydrogen Technologies* estimates that about 25% to 60% of GSE will be electric by 2035. Charger equipment is not standardized, with custom, proprietary systems common. However, the equipment is comparable to L2 or DCFC chargers. Further study is required to determine eGSE quantities and power demand scenarios at ANC.

E.5.2.4 Advanced Air Mobility

Advanced Air Mobility (AAM) powered by electricity is also beyond the scope of this analysis. Pressure to improve environmental and operational performance, combined with innovation in unmanned aerial systems (UAS) and electric vertical takeoff and landing (eVTOL) vehicles, is driving interest in electric AAM. It may still be several years before electric commercial aircraft are certified and UAS and eVTOL applications are commonplace, but ANC should start considering the impact of electric aviation on its operations.

ACRP 2036 forecasts that 2% of the U.S. aircraft fleet will be electric by 2030. It includes a forecast of power requirements for these aircraft, illustrating the scale of power infrastructure upgrades that may be required, as described in **Table E-10**. Electric aircraft manufacturers have typically developed custom, proprietary charging systems comparable to DCFC chargers.

Table E-10
Forecast AAM Power Demand by Type

Type	Power Requirements (Megawatts) per number of Aircraft				
	1	5	10	20	50
Recreational	.02	.10	.20	.40	1.0
Short Range	.06	.30	.60	12	3.0
Commuter	.40	2.0	4.0	8.0	20
Regional	.60	3.0	6.0	12	30

Source: RS&H Analysis, 2024.